DFID

Department for International Development

The Value of Time in Least Developed Countries

(Knowledge and Research (KaR) 2000/01 DFID Research No. R7785)

Final Report

July 2002

I.T. Transport Ltd.

Consultants in Transport
for Rural Development

The Old Power Station, Ardington,
Nr. Wantage, Oxon, OX12 8QJ, UK
Telephone: 01235 833753/821366
Int. + 44 - 1235 - 833753/821366
Facsimile: 01235 832186
E-mail: itt@ittransport.co.uk

TABLE OF CONTENTS

ANNEXES

ABBREVIATIONS

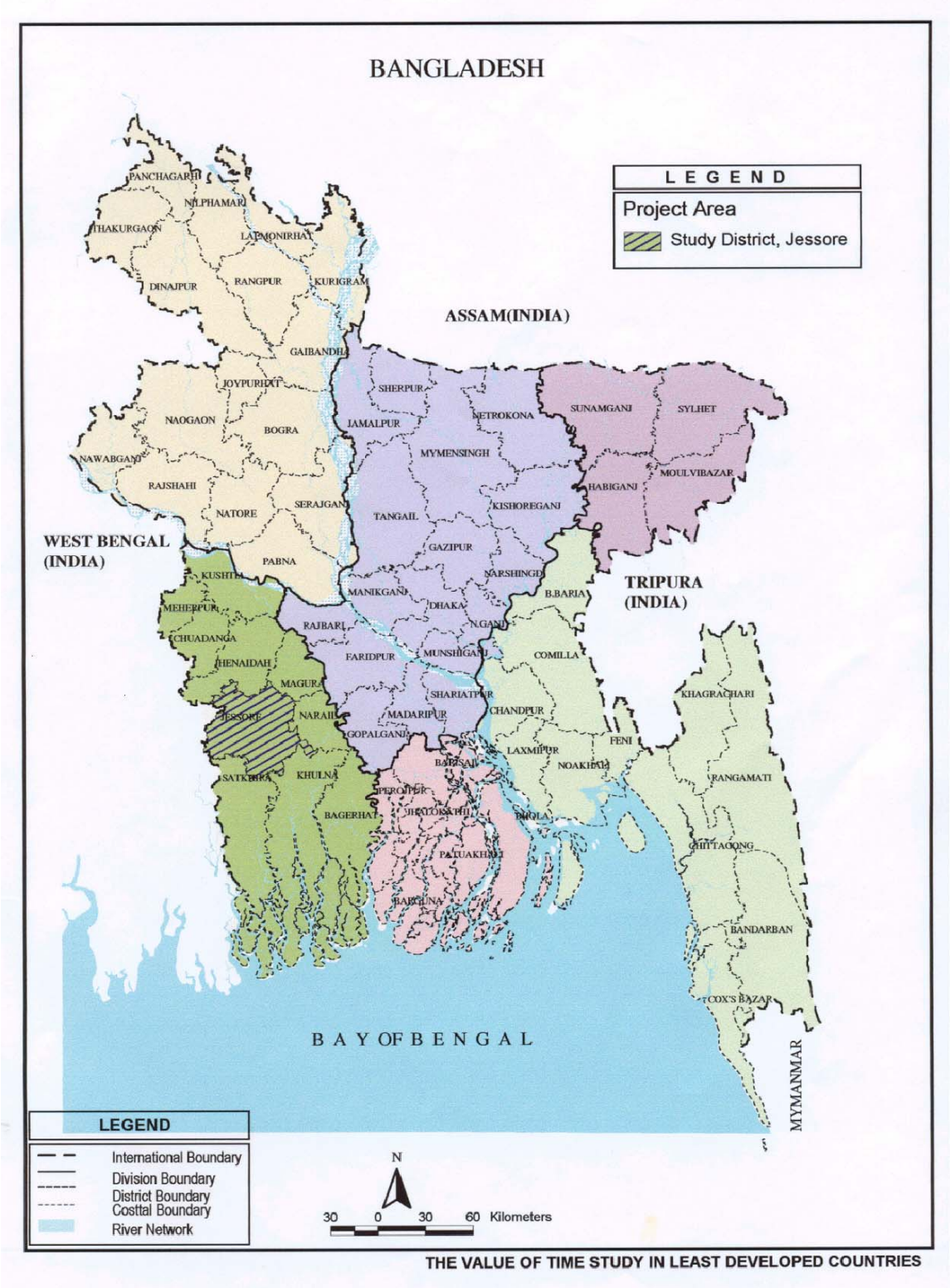
CBN	Cost-of-basic-needs
DFID	Department for International Development
FRA	Feeder Road Type-A
FRB	Feeder Road Type-B
GC	Growth Centre
GDP	Gross Domestic Product
GNI	Gross National Income
hr	Hour
HL	Hierarchical Logit
IMT	Intermediate Means of Transport
IVT	In-vehicle Time
KaR	Knowledge and Research
km	Kilometres
LDC	Least Developed Country
MNL	Multinomial Logit Models
NMT	Non-motorised Transport
MT	Motorised Transport
PPP	Purchasing Power Parity
RDP	Regional Domestic Product
RNF	Rural Non-Farm
RP	Revealed Preference
SCF	Standard Conversion Factor
SP	Stated Preference
sq km	Square Kilometre
SWR	Shadow Wage Rate
Tk	Taka (Bangladeshi Currency)
VOC	Vehicle Operating Cost
VOT	Value of Time
WLKT	Walking Time
WT	Waiting Time
WTP	Willingness to Pay

****

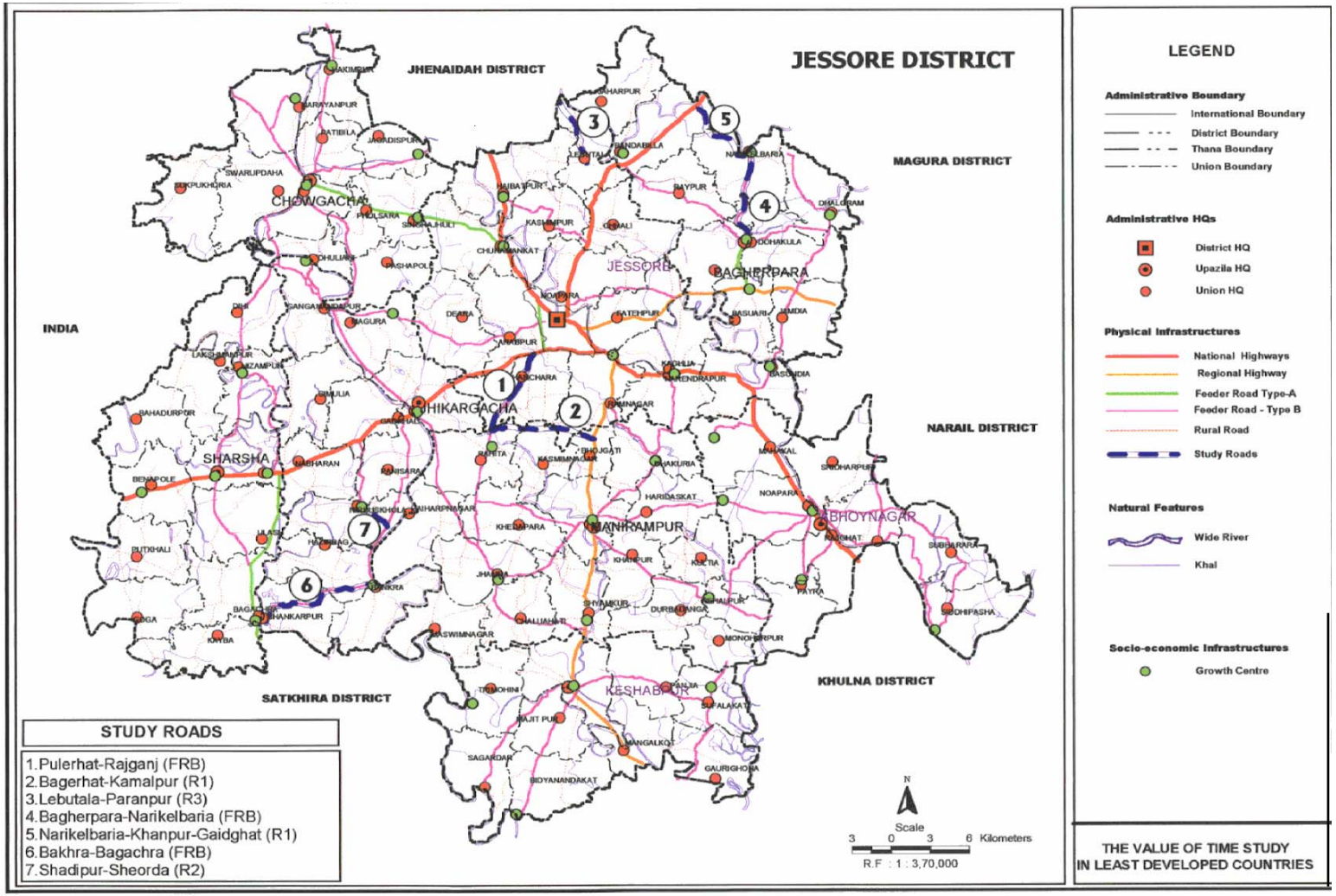
APPROXIMATE EXCHANGE RATE

USD 1.00 = Tk 57

Map I


BANGLADESH
LEGEND
Project Area
Study District, Jessore
ASSAM(INDIA)
WEST BENGAL (INDIA)
TRIPURA (INDIA)
MYMANMAR
BAY OF BENGAL
PANCHAGARH
NILPHAMARI
THAKURGAON
LALMONIRHAT
DINAJPUR
RANGPUR
KURIGRAM
GAIBANDHA
JOYPURHAT
NAOGAON
BOGRA
NAWABGANJ
RAJSHAHI
NATORE
SERAJGANJ
PABNA
KUSHTIA
MEHERPUR
CHUADANGA
JHENAIDAH
MAGURA
JESSORE
NARAIL
SATKHIRA
KHULNA
BAGERHAT
JHALOKATHI
PIROJPUR
BARGUNA
PATUAKHALI
BARISAL
SHERPUR
JAMALPUR
NETROKONA
MYMENSINGH
SUNAMGANJ
SYLHET
HABIGANJ
MOULVIBAZAR
TANGAIL
KISHOREGANJ
GAZIPUR
NARSHINGDI
MANIKGANJ
DHAKA
N.GANJ
B.BARIA
RAJBARI
FARIDPUR
MUNSHIGANJ
COMILLA
SHARIATPUR
MADARIPUR
CHANDPUR
GOPALGANJ
LAXMIPUR
NOAKHALI
FENI
BHOLA
KHAGRACHARI
RANGAMATI
CHITTAGONG
BANDARBAN
COX'S BAZAR
LEGEND
International Boundary
Division Boundary
District Boundary
Costtal Boundary
River Network
N
30 0 30 60 Kilometers
THE VALUE OF TIME STUDY IN LEAST DEVELOPED COUNTRIES

Map II


JESSORE DISTRICT
JHENAIDAH DISTRICT
MAGURA DISTRICT
NARAIL DISTRICT
KHULNA DISTRICT
SATKHIRA DISTRICT
INDIA
CHOWGACHA
JESSORE
BAGHERPARA
JHIKARGACHA
SHARSHA
MANIRAMPUR
ABHOYNAGAR
KESHABPUR
LEGEND
Administrative Boundary
International Boundary
District Boundary
Thana Boundary
Union Boundary
Administrative HQs
District HQ
Upazila HQ
Union HQ
Physical Infrastructures
National Highways
Regional Highway
Feeder Road Type-A
Feeder Road - Type B
Rural Road
Study Roads
Natural Features
Wide River
Khal
Socio-economic Infrastructures
Growth Centre
STUDY ROADS
1.Pulerhat-Rajganj (FRB)
2.Bagerhat-Kamalpur (R1)
3.Lebutala-Paranpur (R3)
4.Bagherpara-Narikelbaria (FRB)
5.Narikelbaria-Khanpur-Gaidghat (R1)
6.Bakhra-Bagachra (FRB)
7.Shadipur-Sheorda (R2)
N
Scale
3 0 3 6 Kilometers
R.F : 1 : 3,70,000
THE VALUE OF TIME STUDY
IN LEAST DEVELOPED COUNTRIES

EXECUTIVE SUMMARY

i. Introduction: the need for a reliable method for estimating rural travel time savings in LDCs

Travel time savings are a major benefit resulting from investments in transport infrastructure and service development. In developed countries these benefits can account for as much as 80% of overall benefits. Usually in a developed country transport investment appraisals quantify travel time saving benefits using standard unit values provided by an appropriate transport/highway agency. In the case of non-availability of such unit values, travel time savings are estimated using an established national practice. However, in developing countries the practice is less well spread despite a common recognition of the fundamental importance of the value of travel time savings in economic evaluation. This is partly because there is a paucity of empirical evidence to support the use of conventional models of value of time (VOT) estimation in developing countries where work patterns, particularly of the poor, are so diverse. Without reliable methods to value travel time savings, economists continue to use vehicle operating costs as means to assess investments (exceptions are urban, inter-urban and multilateral or bilateral donor assisted rural transport projects). This difference of approach leads to a bias of investment decisions that are most unlikely to benefit rural poor and understates the poverty reduction potential of transport interventions in Least Developed Countries (LDCs). The bias stem from the fact that most rural travel and transport in the LDCs is undertaken by poorer people walking and headloading on local roads, tracks and paths and any improvements to local infrastructure and services have potential to bring about large time savings due to modal shifts. In the backdrop of more and more infrastructure investments being made in an attempt to reduce poverty, it is therefore essential that rural travel time savings, especially of the poor people themselves, are valued and factored into investment decisions.

The conventional approaches to valuing time used routinely in developed countries assume that working hours are standard, most people work in formal employment (wage earning), journeys can easily be differentiated into "for work purposes" and "for non-work purposes." While the working time savings are valued based on the augmented wage rate[1], the non-working time savings are valued based on the willingness to pay for travel time saved in order to transfer those time savings to leisure activities.

In rural areas of LDCs informal employment and subsistence living rather than conventional wage earning predominate. The assumptions under which a "western concept" of valuation of travel time savings is based are clearly invalid in the rural context of a developing country. Therefore, the challenge is to develop a method of valuation of travel time savings for rural areas of developing countries which can take into account the diversity of work and subsistence patterns, time use and multi purpose travel and yet can yield values which are robust and simple enough to use in routine economic analysis.

ii. The nature of this study

The purpose of the study was *to develop, empirically test, and disseminate a methodology for deriving VOT in LDCs for transport/accessibility project appraisal*.

[1] Wage rate plus extra costs incurred such as taxes, compulsory contributions etc.

The study was designed to test the applicability of standard methods of assessing the value of time for travellers in rural Bangladesh and, if successful, propose a methodology which would enable the routine inclusion of travel time savings valuation when appraising rural transport projects in developing countries.

The research study was designed to achieve the following four outputs:

i. Null-hypothesis I, "no value can be attached to travel time savings of rural residents in LDCs," is tested;
ii. Null-hypothesis II, "work and non-work journeys for rural residents in LDCs can be differentiated," is tested;
iii. Travel time saving values for rural residents in an area of a developing country for different journey types, modes, seasons and social classes are obtained if the empirical evidence led to the rejection of Null Hypothesis I; and
iv. A useful contribution to the debate on the validity of including values of travel time savings when appraising rural transport/ accessibility projects in LDCs is made.

The concept underlying the valuation of non-working travel time savings is that an individual makes trade offs between time spent in travelling and leisure pursuit. This behaviour can be analysed through preference methods and two existing methods are Revealed Preference (RP) and Stated Preference (SP). The RP analysis estimates values of time which best explain actual observed choices. In contrast, the SP method presents hypothetical choices which provide credible trade off possibilities. This study set out to test whether either of these methods could be usefully used in the measurement of willingness to pay (WTP) to value non-working time savings in a developing country situation.

Comparison of SP and RP methods

Revealed Preference	Stated Preference
• Based on actual choices rather than stated intentions	• Based on hypothetical choices on which individuals base their preferences
• Direct evidence only on the alternative selected. No direct evidence on the alternatives rejected	• A variety of choices can be offered which enable the construction of statistical models
• Unsuitable for use in potential transport improvement situations	• Suitable for use in existing or potential situations
• Expensive to undertake this survey as it can generate only one decision per respondent	• Multiple observations per individual can be generated

The study area was Jessore, a south-western district in Bangladesh. Although the physical, environment and transport characteristics vary across Bangladesh, Jessore District was selected as it represents the majority of the country where there is a predominance of land transport and only a marginal water transport. Bicycles and rickshaw vans are the most used forms of transport in Jessore. Buses ply accessible roads and bullock carts enable access where roads are poor quality. Agriculture is the main source of household income. The study has covered seven paved, partly paved and earth roads of between 3 and 19 km in length.

A series of focus group discussions with travellers, householders in the area and transport operators were conducted at the start of the study to inform the design of the household questionnaire and the RP and SP questionnaires. These discussions also provided an important socio economic context for analysing the results of the preference ranking exercises. In addition, selected male and female travellers from different social groups were interviewed to understand their reasons for travelling and choice of transport modes and how these were related to their socio-economic circumstances. Subsequently the findings were crosschecked after discussion with transport operators. The understanding of socio-economic characteristics obtained from the qualitative appraisal and the household socio-economic survey provided the context for interpreting the empirical results on VOT.

In the study travellers' personal and travel attributes that can influence the VOT were tested in order to establish which ones were significant. In the case they were found significant, the personal and travel attributes values were also calculated. They included:-

- Gender of the traveller
- Income levels of the traveller
- Travelling in wet vs. dry season
- Travelling on market vs. other days of the week
- Travelling with or without a load
- Willingness to pay for reduced walking time
- Travelling on improved vs. unimproved road
- Comfort during the journey[2]

The RP questionnaires compared bus, rickshaw van, bicycle and walking options. The SP questionnaires used a maximum of nine alternatives with two options for each alternative. A total of three attributes with a maximum of three levels were used in designing each of the SP questionnaires. Because of the high levels of illiteracy, interviewers posed the questions and explained the alternatives. Respondents chose one from two options provided against each alternative.

SP and RP questionnaires were administered on the roadside in two rounds; one in the wet season and the second in the dry season. A total of 784[3] RP Questionnaires were administered and 1547[4] SP questionnaires. Concomitant household income/expenditure questionnaires were administered in order to ascertain respondents' economic status and time-use patterns. Use of travel purpose questionnaires helped in an understanding of the travel purposes of the travellers.

Preference questionnaire results were compiled and were analysed with an ALOGIT software. The analyses provided model coefficients and their statistical significance. Values of time were calculated by dividing the particular coefficient with its cost coefficient. Reconciliation of responses with different preference exercises was facilitated through use of Hierarchical Logit (HL) modelling techniques.

[2] defined as uncrowded and able to get a seat for the major part of the journey.
[3] 269 in wet season (from a total of 333 administered) and 515 in the dry season.
[4] approximately equal proportions between wet and dry season.

iii. Main findings

The RP methods failed to provide consistent results. Closer analysis of the results suggests that this can be largely attributed to the fact that for many travellers the options are very limited (and often none at all, but to walk) and therefore no trade offs can be made and no meaningful valuation of travel time savings can be calculated. Furthermore, commercial vehicles in rural Bangladesh generally do not run to a schedule but wait until the vehicle is full before moving off. This means that waiting times can vary enormously and complicates the issue when travellers try to compare modes of transport. Since rural people rarely wear watches, their recall on waiting and in-vehicle time may not be accurate and this further complicates the administration of the RP methods.

However, the application of the SP methods was successful. All types of traveller were able to make choices about preferred travel options and were able to make rational justifications for their choices. The SP methods were found suitable for different infrastructure types and travel alternatives.

The computation of the SP questionnaire answers led to the following estimates of travel time savings values:

Base values of travel time savings	**Men**	**Women**	**Average**
In-vehicle time	4.75 Tk/hr[5]	2.25 Tk/hr	3.50 Tk/hr
Walking time	5.16 Tk/hr	2.66 Tk/hr	3.91 Tk/hr

Additional computed values	
Uncomfortable travelling conditions	2.29 Tk/hr
Market day	1.47 Tk/hr
Salaried or traders	14.72 Tk/hr
Social and leisure	Not an additional factor
Travelling with a load	0.48 Tk/hr
Poor traveller[6]	0.31 Tk/hr
Poor road	Not an additional factor
Wet season	Not an additional factor
Mode of transport (bus/rickshaw van)	Not an additional factor

[**Note:** While reading the report and viewing the results, readers should keep in mind that the value of non-working time was judged in relation to what people were prepared to pay to save time. This means that the base value of time for any journey was what people were WTP to shorten the journey and to transfer the saved time to leisure activities. Additional values for different conditions (e.g. an uncomfortable journey) are then the WTP values to shorten the journey under those conditions. The above results show that the VOT for an uncomfortable journey is more than for a comfortable journey. This means that people are prepared to pay more to shorten an uncomfortable journey than a comfortable one.]

This suggests a number of significant conclusions specific to the SW Bangladesh situation:

[5] Tk/hr is Bangladesh Taka per hour. 1 Taka is equivalent to US$ 0.017 (2001). Rural wage rate varies enormously across the country but is generally quoted as an average of 6.25 Tk/hour

[6] as determined by per capita household consumption data collected through household survey

- Men attach about double the in-vehicle time savings values compared to women.
- Willingness to pay by salaried persons and traders is four times the base average in-vehicle value.
- Travelling with a load increases the value of time by about 14% over the average base value.
- Market day travel attracts a higher VOT, equivalent to about 42% above the average base value.
- Poor travellers valued their travel time some 9% above the average base value. This higher figure may look counterintuitive at first if considered in a developed country context. The conventional belief is that the VOT increases with increase in household income, although not proportionately. However, the poor in Bangladesh – both men and women – operate on a very tight time budget. An average poor person spends significantly less time for social and leisure activities compared an average non-poor person. They tend to make best use of their time in income earning activities in order to survive in a country with a very high population but with a few opportunities. Also there is a tendency to earn an extra amount whenever opportunities come in order to secure themselves financially for future bad times as the state takes very little responsibilities.
- Uncomfortable travelling conditions attracted a value of 63% above the average base level.
- People make no distinction between travelling for essential and non-essential (e.g. travel for the purpose of social and leisure) purposes. Thus, the base value of time is appropriate for all types of journeys. By placing similar values on all journeys rural Bangladeshis are seemingly factoring in the productive nature of 'social' trips[7]. However, this aspect needs further in-depth re-examination in a future study.
- The condition of the road, mode of transport and season are not additional significant factors over the average base value.
- Although walking time has a higher value than in-vehicle time (12%) the difference is much less than in developed countries where it is often as high as 100%.

Using these figures, value of time estimates can be made for different situations. For example, the value of time for a man travelling on market day with a load would be calculated at Tk 6.70/hr (base value (Tk 4.75/hr) + market day (Tk 1.47/hr) + load (Tk 0.48/hr) = Tk 6.70/hr). A base value for an average traveller on a rural road in Bangladesh was estimated at Tk 4.30 per hour.

The issue of work and non-work travel intrinsic to travel time savings valuations in developed countries was further reviewed. In fact less than 1% of trips could be categorised using the traditional definition of work trips (those undertaken when working for an employer). Adding "self employed working trips" and "purchasing/selling goods for profit" increased this proportion to 21%. Considering the nature of rural economy in Bangladesh, it appears justifiable to redefine working trips. The newly defined working trips include: trips made in the course of work for an employer, trips made in the course of work as self employed, and trips made for purchase/selling of goods for profit. Time saving values of theses trips should at least be equal to the wage rate - calculated at Tk 6.82 per hour for the study area.

[7] time spent in family gatherings, community meetings, networking , religious activities etc may be considered as an important aspects of social capital accumulation.

After adjustments to correct market distortions caused by unemployment, underemployment, taxes and subsidies, the following economic travel time saving values were obtained:

- Working VOT 5.10 Tk/hr
- Base non-working VOT for an average traveller on a rural road 3.80 Tk/hr

The working and non-working travel time savings values were adjusted with a shadow wage rate factor (calculated at 0.75) and a Standard Conversion Factor (calculated at 0.88) respectively.

Only 14% of the trips were stated as being multi purpose. This relatively low proportion could be due to the trip patterns in rural Bangladesh – frequent but short trip characteristics. However, this finding may be considered unique to Bangladesh or a country with a high population density and short distances to facilities and services.

Women attach a much lower value to time savings than men. This may be a reflection of the fact that women in rural Bangladesh rarely have access to household finances thus limiting their options, that differences in wage rates for men and women are considerable and that women's contribution to the household (productive and reproductive) is rarely acknowledged in financial terms.

iv. Conclusions

Conclusion on outputs

Output 1: Null-hypothesis I, "no value can be attached to travel time savings of rural residents in LDCs," is tested;

- The null hypothesis can be rejected as the results of the field study showed that rural residents can, indeed, attach a value to travel time savings – these values were found to be are statistically significant and were estimated using modelling process following standard statistical procedures.

Output 2: Null-hypothesis II, "work and non-work journeys for rural residents in LDCs can be differentiated," is tested;

- The null hypothesis cannot be rejected as the field study results showed that work and non-work journeys can be differentiated. However, if the conventional definition is followed, only a marginal proportion of trips can be categorized as work trips. Considering the nature of rural economy in LDCs, there is a need for redefining the work trips.

Output 3: Travel time saving values for rural residents in an area of a developing country for different journey types, modes, seasons and social classes are obtained if the empirical evidence led to the rejection of Null Hypothesis I;

- As a consequence of rejection of Null-hypothesis I, the travel time savings values are estimated and presented in the previous section.

.

Output 4: A useful contribution to the debate on the validity of including values of travel time savings when appraising rural transport/ accessibility projects in LDCs is made.

- This output can be considered to have been achieved. The study findings were presented in a final workshop, attended by professionals, academics, representatives from relevant DFID divisions and a representative from a multilateral lending organisation. Written comments from the participants helped in the finalisation of the study report. A large number of requests expressed through informal contacts show the interest generated by the study. The study findings will be disseminated using DFID's transport links website (www.transport-links.org). Also the findings will be published in relevant national and international journals and conference proceedings.

Conclusion on research purpose

The purpose of the research was *to develop, empirically test, and disseminate a methodology for deriving VOT in LDCs for transport/accessibility project appraisal*.

- Bangladesh study suggests that the western concept of dividing travel time savings into working and non-working time savings is valid in developing country context. However, working trips will need redefining depending on the nature of the rural economy of a developing country. The proportion of trips under working trips category may only be marginal following conventional definition of these trips as the results of the study suggest. The redefined working trips should include trips those have opportunity costs of lost time equal to the marginal value of income of the travellers.
- Between the RP and SP approaches for valuation of non-working travel time savings, SP method is found to be the most suitable, as its suitability was successfully tested for different infrastructure and travel alternatives.
- There is a need to adjust the working time saving values, when equated to the wage rate, with a shadow wage rate factor and the non-working time saving values with the Standard Conversion Factor (SCF). In the case of working time saving values such adjustments are necessary to represent the resource value of productivity of labour in an alternative use. The wage rate may not always represent the resource value due to the market distortions caused by unemployment, underemployment, taxes and subsidies. The non-working time saving values also need an adjustment to adjust for taxes and subsidies.

v. Concerns

The results obtained in this study are specific to the area in Bangladesh studied. Clearly, physical, agricultural, transport infrastructure and socio economic features will have strong influence on the specific base values and additional attribute values. The process of administering the questionnaire may require adaptations in other cultures.

SP questionnaires take a long time to administer and require patient explanation and probing of responses to ensure respondents have understood the implications of their choices. Interviewers need careful and sensitive training and monitoring. The standard statistical modelling techniques required to analyse the data coupled with the huge volume of data can make computation very complex. This may require high levels of statistical skills.

Concerns surround the cultural context for valuing time. For example, this study indicates that women value their own time much less than men. Is this a function of their limited

choices and traditional role and therefore, is it a fair estimation of the value of time for economic analysis? Ethically, should economists accept this self assessed value of time?

The study also had difficulty using the SP method with children partly because they had had little experience of alternative modes of transport and partly because of the complexity of the choices offered. Children make economic contributions to the household, especially poor households and travel time to school may play a critical role in their or their parents' decision to attend school or not in order to continue to carry out domestic and productive works. Therefore, in any future study greater efforts would be required so that the SP exercises can capture children's mode choice decisions.

Explanations of the values rural Bangladeshis attach to travel time savings provided through this study have been largely speculative. Further qualitative research would enable fuller understanding of the bases of these values and enable extrapolation to other contexts.

This study assessed the affect on value of time of travelling with a load but did not examine the nature of the load. The size, perishability and value of the load may significantly influence travel mode decisions. These factors were deliberately set aside to avoid complicated analyses.

vi. Recommendations

Bangladesh exhibits a number of specific characteristics which make generalisation from this study problematic; it has a very dense population (about 900 per sq km), high proportion of landless seeking work (roughly 40% of the rural households are landless) and a well developed non-motorised transport sector. This study needs to be extended to other developing countries, particularly those exhibiting very different transport, population and cultural context from Bangladesh.

The study findings are not relevant to the transport sector only. Its findings may also be extended in the appraisal of other sectors. Notable among them are water and health sectors. However, further empirical studies would be required to test the applicability of the approach in different circumstances.

Following further empirical studies, this approach to valuing travel time savings in developing countries needs to be disseminated through user friendly technical guidelines ('How to' manuals) as well as policy guidelines.

BACKGROUND AND THEORY

1.0 INTRODUCTION

Travel time savings are a major benefit resulting from investments in transport infrastructure and service development. In developed countries these benefits can account for as much as 80% of overall benefits. Usually in a developed country transport investment appraisals quantify travel time saving benefits using standard unit values provided by an agency responsible for overseeing the development of transport. In the case of non-availability of such unit values, travel time savings are estimated using an established national practice. However, in developing countries the practice is less well spread despite a common recognition of the fundamental importance of the value of travel time savings in economic evaluation. This is partly because there is a paucity of empirical evidence to support the use of conventional models of value of time calculation in developing countries where work patterns, particularly of the poor, are so diverse. Without reliable methods to value travel time savings, economists continue to use vehicle operating costs as a means to assess investments. Exceptions are urban, inter-urban and multilateral or bilateral donor assisted rural transport projects. This difference of approach leads to a bias of investment decisions that are most unlikely to benefit rural poor and understates the poverty reduction potential of transport interventions in Least Developed Countries (LDCs) [8]. The bias stems from the fact that most rural travel and transport in the LDCs is undertaken by poorer people walking and headloading on local roads, tracks and paths and any improvements to local infrastructure and services have potential to bring about large time savings due to modal shifts. In the backdrop of more and more infrastructure investments being made in an attempt to reduce poverty, it is therefore essential that rural travel time savings, especially of the poor people, are valued and factored into investment decisions.

It has been long felt that issues regarding value of time (VOT) savings in developing countries, especially in the rural context of LDCs, need to be addressed in a rigorous manner. There are a few reasons that a "western concept" of travel time savings is inapplicable in developing countries' context, particularly in the rural context. Even if it is applied, it will need some adaptations. The reasons for such inapplicability are summarised below:

- So far, no known systematic attempts have been made to support or reject the validity of theoretical models applied in developed countries for justifying the value of travel time saving in the context of developing countries, apart from a few middle income developing countries;

[8] "Least developed countries" (LDCs) is a UN classification of countries based on three criteria (UNCTAD, 2001):

(a) a low-income criterion of gross domestic product (GDP) per head (three-year average) below US$ 900 (though there is a higher threshold for graduation out of the LDC category);
(b) a human resource weakness criterion based on indicators of health, nutrition, education and adult literacy, and
(c) an economic vulnerability criterion based on instability of agricultural production and exports, diversification of production and exports and size of the population.

There are 49 countries (including 34 African countries) in this category. They contain 10 per cent of the world population and generate 0.5 per cent of the world GNP.

Given that LDCs are a subset of developing countries, issues related to developing countries are also normally relevant for LDCs. Where an issue is only related to LDCs this has been mentioned specifically.

- The western model divides time savings into two categories – "working" and "non-working". While the work travel time savings are the time saved in the course of the employment (i.e. the travel time saved while on work), the non-working travel time savings are the time saved in non-work periods, including commuting. In the rural context of LDCs, where western type formal employment[9] is almost non-existent and it is argued that people often make complex multipurpose trips, it may be difficult to precisely define 'working' and 'non-working' time;

- In the case where the value of travel time savings is equated to a wage rate under the assumption that the marginal productivity of labour is equal to the wage rate, it may not represent the resource value of productivity of labour in an alternative use. This is due to market distortions such as an existence of unemployment, underemployment, taxes and subsidies. Therefore, there is a need for a shadow pricing of the wage rate to better represent its resource value

- Using earnings as a guide to marginal productivity faces the objection of inequity. It is often argued that the use of the 'wage rate' as the value of time might bias the investment toward the well-off, who use the transport infrastructure most extensively; and

- There is very little empirical evidence that can be used to attach a value to the travel time savings of the rural population engaged in subsistence activities in developing countries. Exceptions are a few studies in middle income countries.

Given the situation described above, a research project entitled "The Value of Time in Least Developed Countries" was initiated under the Department for International Development's (DFID) Knowledge and Research (KaR) Programme. The project was spread over two years (FY 2000-01 to 2001-02).

1.1 Purpose of the research

The purpose of the research was *to develop, empirically test, and disseminate a methodology for deriving VOT in LDCs for transport/accessibility project appraisal*. Attainment of the research purpose has potentially far reaching implications in the theoretical and empirical investigations of the value of travel time savings in developing countries in general, and rural areas in developing countries in particular.

[9] Normally defined as employment by established employer with defined remuneration and other benefits such as paid leave and pension schemes

1.2 Outputs of the research

The research study was designed to achieve the following outputs:

v. Null-hypothesis I, "no value can be attached to travel time savings of rural residents in LDCs," is tested;

vi. Null-hypothesis II, "work and non-work journeys for rural residents in LDCs can be differentiated," is tested;

vii. Travel time saving values for rural residents in an area of a developing country for different journey types, modes, seasons and social classes are obtained if the empirical evidence led to the rejection of Null Hypothesis I; and

viii. A useful contribution to the debate on the validity of including values of travel time savings when appraising rural transport/ accessibility projects in LDCs is made.

1.3 Position paper and interim report

In June 2001, as a first step of the research, a 'position paper' was prepared. The paper reviewed: (a) the theoretical foundations for valuing travel time savings; and (b) some of the relevant empirical evidence on values of travel time savings from developed and developing countries. On the basis of such reviews, researchers' initial views on the relevant issues for valuing travel time savings in the rural context of LDCs were put forward and a detailed research methodology was proposed. The 'position paper' formed the basis for the subsequent discussion in an expert group workshop, attended by consultants, academics and DFID representatives in July 2001. The workshop participants identified the following issues as being worthy of more attention than indicated in the position paper:

a) more focus on poorer and more vulnerable members of communities;

b) ensuring that the project is not simply road based, but also targets access to key services used by poor and considers opportunity costs and gender issues;

c) investigation of the option of labour markets as a potential method for estimating the value of time; and

Items (a) and (b) have been incorporated in the study design and the related results have been discussed in Section 10.0. Issue raised in items (c) had been investigated and is reported in Section 10.0.

The first round (wet season) of field data collection took place in July-August, 2001 in Jessore, a south-western district in Bangladesh. The study team collected information on the socio-economic and transport contexts in Bangladesh in general and the study area in particular during the field visits. Based on the preliminary findings from the analyses of first round (wet season) of data, an interim report was prepared in December 2001. The second

round of data collection (dry season) was undertaken in January 2002. Findings and conclusions from the analyses of both rounds of field data are presented in this final report.

1.4 Structure of the report

Apart from the introduction, the report has the following ten major sections:

Section 2: Reviews the relevant theories related to the value of travel time savings and their relevance in the developing country context;

Section 3: Explains the standard methodological approaches available for valuing working and non-working time savings, including the potential sources of variation of the value of non-working time savings;

Section 4: Explains the theoretical basis for estimation of willingness to pay (WTP) for valuing non-working time savings;

Section 5: Critically reviews the different approaches to valuing travel time savings in developed and developing countries;

Section 6: Explains the relevant issues in the valuation of the travel time savings in LDC;

Section 7: Presents the socio-economic context of Bangladesh and the research area, Jessore District;

Section 8: Describes the research methodology adopted in conducting the research;

Section 9: Presents and discusses the results from socio-economic and travel purpose data analysis;

Section 10: Presents and discusses travel time saving values and other related methodological issues; and

Section 11: Presents the conclusions of the study.

2.0 THE VALUE OF TIME: A REVIEW OF THEORIES

Several elements need bringing together for the development of a sound basis for valuing travel time savings. The most important among these is the adaptation of the classical theory of consumer behaviour in time allocation problems in relation to transport related attributes. The outcome of this exercise is a model which can be estimated empirically making use of the 'random utility' theory of discrete choice. MVA/ITS/TSU (1987) provides an in-depth theoretical overview of the relevant theories of the valuation of time in the transport context.

Adaptation of the classical theory of consumer behaviour in time allocation problems, utility maximization under different constraints, and simplification of the subsequent equations provide the following final equations (See Annex-I for detailed derivations of the equations):

$$(\delta U/\delta t_j)/\lambda = w + (\delta U/\delta t_w)/\lambda + (\varphi/\lambda) - (\psi_j/\lambda) \ldots\ldots (2.1)$$

$$(\delta U/\delta t_j)/\lambda = \mu/\lambda - \psi_j/\lambda \ldots\ldots (2.2)$$

Where, w is the wage rate, t_w and t_j are the time spent in work and activities other than work respectively, and $(\delta U/\delta t_j)/\lambda$ is the 'marginal valuation of time spent on activity j' – a ratio of marginal utility of time in activity j ($\delta U/\delta t_j$) and marginal utility of income (λ). The second, third and fourth terms in the right hand side of Eq. 2.1 are the marginal valuation of time spent on work, marginal valuation of time for decreasing the minimum working time required and marginal valuation of decreasing the minimum other time required respectively.

When ψ_j is zero in Eq 2.2, i.e. when the time constraint does not bind, the marginal valuation of time in activity j is equal to μ/λ, also known as the 'resource value of time'. It represents consumer willingness to pay to have the total time budget increased, although in reality complete relaxation of the time budget constraint is not feasible. This is interpreted as the marginal valuation of the 'pure leisure' time at the optimum.

It is important to clarify one point with regard to the value of leisure time. Eq. 2.2 shows that 'pure leisure' time has a value, as utility is derived from it. However, there is generally no value, at the margin, for the leisure time saved - any savings in one leisure activity can only be used in another leisure activity[10]. Given that saving leisure time in one activity and transferring it to another activity will not increase an individual's utility, it is implicit that the consumer will not be prepared to pay to save any leisure time.

It is also important to differentiate between the marginal valuation of time and value of time savings. It was seen that while leisure time has a marginal value, the value of leisure time savings is zero. Now let us turn to other activities than leisure where the time constraint does bind[11], for example travelling. The difference between the marginal valuation of time spent on travelling (or activity i) and resource value of time (marginal valuation of pure leisure time) is ψ_j/λ. Therefore, a reduction of the amount of time spent on travelling (or activity i) and transferring it to leisure will increase utility, which is equal to ψ_j/λ. This is referred to as "the value of transferring time" or commonly as the "value of time". Hence the empirical interest in valuing time is centred on the value of ψ_j/λ. Also the marginal valuation of activities other than leisure will be less than the resource value. In the case of travelling, the marginal valuation of travel time, in most cases, will be negative as travelling contributes to disutility. Therefore, the value of ψ_j/λ is never negative and will always be non-zero if someone is forced to spend more time in an activity than he or she ideally wishes.

3.0 VALUATION OF WORKING AND NON-WORKING TIME SAVINGS

The theoretical framework explained in Section 2.0 is valid both in the developed and developing country context. Only the empirical approaches in the valuation of travel time savings may vary between developed and developing countries.

As mentioned before, in developed countries two distinctions are made when valuing travel time savings: working and non-working time savings. The general approach of such valuations is given below.

[10] However, this may not be true in the case of transferring time from one leisure activity to another leisure activity that attracts higher utility.
[11] Also referred as "intermediate activities."

3.1 Valuing working time savings

Time savings while travelling for work is the marginal value of working time – unlike for other activities, it is the difference in value between marginal value of time for the particular activity and leisure time. The value of working time savings for a travelling employee is taken as the marginal valuation of employee's time to the employer. The classical economic theory of marginal productivity, which maintains that labour will be hired up to the point where the marginal value of an extra unit of labour is equal to the cost of that unit, underlies the valuation of the working time savings. The value of working time savings is generally taken as the wage rate plus other costs, for example, employment taxes, other compulsory contributions, and an allowance for overheads, to keep someone employed. An important assumption for this valuation of working time savings is that the employee will behave in such a way that he/she has personally accepted such a valuation. However, there may be many reasons for failure of such theory in practice, among other, monopolistic practices in labour market, limited possibilities in substitution between labour and capital, and divergence from the profit maximising assumption of the traditional theory. The implications of these arguments are very difficult to ascertain. Given the practical difficulty in assessing the implications of failure of the theory, it is an accepted practice to value the working time savings equal to the wages plus the on-costs.

The aforementioned approach makes several implicit questionable assumptions: a full transfer of work related travel time saved to work only; a non-productive use of travel time i.e. employee does not use any of the work travel time for productive purposes[12]; and a similar utility of time spent on work compared to travelling. Against such criticism, the following formula was proposed by D A Hensher in late 1970s, also known as the Hensher model, for

$$VTTS = (1 - r - pq) * MP + \frac{1-r}{1-t} * VW + \frac{r}{1-t} * VL + MPF$$

valuing work related travel time savings (Booz-Allan& Hamilton, 2000):

Where:

VTTS =	value of travel time saved;
r =	proportion of travel time saved which is used for leisure;
p =	proportion of travel time saved at the expense of work done while travelling;
q =	relative productivity of work done while travelling compared with the equivalent time in the office;
MP =	the marginal product of labour;
VL =	the value to the employee of leisure relative to travel time. Traditional behavioural value of time;
VW =	the value to the employee of work time while in the office relative to travel time;
MPF =	the value of extra output generated due to reduced fatigue; and
t =	employee's personal tax rate.

[12] for example, the employee may still be working on a train using a lap-top

It is to be noted that there are four main elements of the formula – a productive effect, a relative disutility cost, a loss of leisure time and any compensation transfer from employer to employee. However, use of Hensher model in valuing work travel time saving is marginal given the difficulty in making it operational in practice. The Hensher model has been used for the valuation of work related travel time savings concerning business air travel and commercial car travel in countries like Australia, Sweden, UK and the Netherlands (Booz-Allan& Hamilton, 2000).

3.2 Valuing non-working time savings

Unlike the values of working time savings, the value of time savings for a particular activity other than wage earning work (non-working time savings) is the difference between the marginal valuation of time for the particular activity and leisure. The values of non-working time savings are assessed empirically using stated or behaviourally revealed values. These stated or behaviourally revealed values are considered as someone's willingness to pay for preferring to have travel times saved and transferring them to leisure activities. For example, if a rational person chooses, either by showing behaviourally or by stating such intention when asked under controlled experimental conditions, an expensive but faster mode over a cheap but slower mode of transport then it is implicit that he/she is prepared to make a trade off in favour of time at the expense of money. This shows his/her willingness to pay for avoiding the extra time in a slower transport mode and transferring the amount of time to leisure.

The most common theoretical framework for empirical measurements of the non-working time savings is based on the discrete choice model that hinged on the framework of the random utility theory (Ortúzer and Willumsen, 1996). The random utility theory postulates that all behaviour of a rational person is explained by his/her desire to maximise utility apart from random variations in behaviour due to errors in measurement by the analyst, errors in the perception of the individuals and variation of taste between individuals. In the case of transport it practically means that a rational person will choose a mode or an option that gives him/her the greatest net utility. For instance, say there is a set $A = \{A_1, A_2, \ldots A_n\}$ of available mutually exclusive alternatives and a set of X vectors of measured attributes of the individuals and their alternatives. Now, If a person q is endowed with a set of attributes $x \in X$ and in general will face a choice of $A(q) \in A$. Each option $A_j \in A$ has an associated net utility of U_{jq} for the individual q. The utility U_{jq} has two portions – a measurable, systematic and representative part (V_{jq}), which is a function of the measured attributes x, and a random portion ε_{jq}, which reflects the random variations in behaviour due to errors in the perception of the individuals and variation of taste between individuals and the measurement errors made by the modellers. The individual q will select alternative A_j only if $U_{jq} \geq U_{iq}$, under a condition that for all $A_i \in A(q)$. The simplest assumption of such utility is that they are linearly additive and compensatory – alternatives between which choices are made are characterised only by utility. For instance, the simple form of compensatory utility model, which is frequently used in transport, may take the following general linear form:

$U_i = a_0 + a_1 X_1 + a_2 X_2 + \ldots a_n X_n$; where U_i is the utility of the option i, $X_1 \ldots X_n$ are the product attributes, $a_1 \ldots a_n$ are the model coefficients, and a_0 is the model constant.

The framework of discrete choice models, making use of disaggregate data on individuals' choices between specified alternatives, are used for valuation of non-working travel times savings. There are certain advantages of such disaggregate models, *inter alia*: they are based on individual choices and therefore the models attempt to explain individual behaviour; they are more efficient in information usage as they make use of individual data which facilitate the use of inherent variability in the information; and they can be used at any aggregation level. These derived values, an end product of the modelling process using the observed behaviour or reported potential behaviour, are known as "behavioural values of time". However, often these values may not be agreed by the policy makers for use in transport project appraisal due to: (i) misperception by the individual; (ii) taxation and subsidies such that the cost affecting the individual is not the true resource cost; (iii) individual values are all short run, but public transport policy involves long run consideration. Therefore, these values are often converted to resource values by multiplying them with some factors.

Given that the non-working time savings is the willingness to pay for saving travel time and transferring that amount of time to leisure, its values are dependent on the respondent's social, economic, demographic characteristics or on other factors. The following personal and travel attributes may contribute to major variations in the valuation of non-working time savings: (i) household income; (ii) household composition; (iii) person type; (iv) journey purpose; (v) out of vehicle time during the journey (for example, walking and waiting time) (vi) season/day of travel (for example, busy vs. lean time of the year, market vs. non-market day; (vii) mode of travel; and (viii) amount of time savings.

4.0 ESTIMATION OF THE WILLINGNESS TO PAY FOR THE VALUATION OF NON-WORKING TIME SAVINGS

The willingness to pay for a preference can be identified in two major ways: Revealed Preference (RP) and Stated Preference (SP). RP is based on the actual choice framework. By observing the choices made between alternatives with specific attributes we can estimate the values of different attributes – including time. For instance, if an individual is faced with two choices for going from A to B – travelling by train which is faster but expensive or travelling by coach which is slower but cheaper. Say the times and costs for travel are T_t and C_t, and T_c and C_c for train and coach respectively. Then the time and cost differences are (T_c-T_t) and (C_t-C_c) respectively. Under this circumstance the boundary value of time is $\{(C_t-C_c)/(T_t-T_c)\}$- which practically means that any individual with value of time equal to $\{(C_t-C_c)/(T_t-T_c)\}$ will be indifferent between the train and bus. All else equal, an individual with value of time higher than $\{(C_t-C_b)/(T_t-T_b)\}$ would choose train or vice versa. The choice outcome of the RP study is the known outcome, which is the only response. Conceptually this should be the most realistic way for evaluating the values of time since it reveals the choice in the real world. However, it tends to be expensive as only one decision per respondents can be analysed. Another major pitfall of the RP study is that, when a range of choices exists, direct evidence only exists on the alternative chosen and not on the alternative rejected. Also, in the case where no trade-offs exist, no information can be generated. In addition, a RP study is

ineffective in cases where new transport interventions are under consideration, which necessitates the use of hypothetical scenarios for evaluation of the impact of the new interventions. Hine, Pangihutan and Rudjito (1998), from an Indonesian study, confirmed that it is difficult to use RP methods in the meaningful valuation of travel time savings when there is a limited range of choices.

SP methods offer the opportunity to overcome the limitations of the RP methods in modelling travel choices. SP experiments present the individuals with hypothetical travel choices and seek their preferences. This is done through offering respondents different alternatives designed to give several credible hypothetical trade-offs in their travel decision making. SP methods have become the main methods in determining the travellers' time values. The UK experienced a diminished use of RP methods in the valuation of travel time savings from early 80s to late 90s. This is due to two reasons: (i) in the early 80s some VOT studies were successfully conducted using the SP methods in the UK; and (ii) it was found that there was a reasonable degree of correspondence between the value of time estimates using RP and SP methods (Wardman, 1997). Since late 90s use of RP methods has become non-existent.

One of the main reasons for the overwhelming popularity of the SP methods originates from the fact that the researcher can precisely control the choices offered to respondents and thereby can ensure data of sufficient quality to construct a good quality statistical model. This is in contrast to RP methods where the observations may not vary sufficiently to construct a creditable model (Pearmain & Kroes, 1990). This inherent advantage of the SP methods allows the separation of effects of variables of interest from the effects of other factors. Other advantages of the SP methods include their use in a hypothetical situation where potential interventions are planned and the generation of multiple observations per individual given that the respondents are asked to consider a number of situations. The main criticism of the SP techniques lies in the fact that it may not correspond closely to actual preference of the respondents; this may be due to the systematic biases in the SP responses or difficulty of designing and carrying out the SP experiments (Wardman, 1988). These drawbacks were, perhaps, the reasons for some degree of skepticism among economists on the use of SP methods.

An alternative to the direct methods for valuing time based on the random utility model is the hedonic pricing model that attempts to estimate the value of time and other attributes through their effect on the value of residential property or land or wage rate. For example, a location near an airport may be expected to have a negative effect on the value of a house whereas a location near amenities (places of employment and schools and areas of natural beauty) would have positive effects (Nelson, 1982, Smith and Karou, 1990 and Braden and Kolstad, 1991). Pendleton and Mendelsohn (2000) show that random utility and hedonic travel cost models are based on a similar theoretical framework.

5.0 PRESENT APPROACHES TO VALUATION OF TRAVEL TIME SAVINGS IN DEVELOPED AND DEVELOPING COUNTRIES

5.1 Developed countries

Table 1[13] provides the summary of the approaches undertaken in some of the selected developed countries for travel time savings valuation. Close examination of Table 1 shows the following:

(i) Approaches to the valuation of travel time savings and the values of time vary a great deal among developed countries;

(ii) Some countries, like the UK, USA and Germany, differentiate between working and non-working time savings and others simply use a unique value, like France, Japan, Austria, Belgium and Greece;

(iii) Categorisation of time saving values also varies widely; and

(iv) Whilst valuations of working time savings are based on wage rates, the non-working time savings are mainly valued using RP or SP approach.

Bristow and Nellthorp (2000) present the range of variation of working and non-working time saving values in different European countries – values of working time savings range from 5.3 to 19.5 US$ per hour per person and values of non-working time savings range from 2.0 to 4.5 US$ per hour person. Non-working time savings vary between 10 to 42% of the working time values in Europe (Bristow and Nellthorp, 2000).

[13] Summarised from Vickerman (2000), Rothengatter (2000), Quinet (2000), Morisugi (2000), Lee (2000), Bristow & Nellthorp (2000) and Hayashi & Morisugi (2000)

Table 1: Comparison of approaches to the valuation of travel time savings and standard values in selected countries

Country	Method	Categories	Working VOT US$/hr/ person	VOT (non-working) US$/hr/ person	Other Remarks
UK	Working time based on wage rate. Non-working time based on SP or RP studies	Values Differentiated by vehicle types and driver/passenger for each of working non-working categories	18 (car)	4.4 (unique value for all vehicles)	No differentiation by time of the day or non-working time trip type. Cargo time values not specified
France	Wage rate approach or SP or RP studies	Unique value for working and non-working time	4.5~19 (depending on the type of project)		Values differ for different project type with road project has the lowest value
Japan	Mainly wage rate approach	5 categories depending on vehicle categories and 2 categories for type of day (weekday or holiday)	19.5 (car weekdays) 21 (car weekends)		No differentiation by trip purpose. VOT does not depend on time of trip and other
USA	Wage rate approach (basically for working hour) or SP or RP studies	Working travel is valued at wage rate and personal travel at lower fraction of the wage rate on the trip purpose	8~40		The cargo time values are routinely used primarily representing inventory costs.
Germany	Mainly wage approach adjusted by WTP using SP. Non-working time values also adjusted for small time savings	2 categories of purpose; 4 categories of cars; one category of rail	13.5 (car)	2.6 (car)	The cargo time values are not specified
Austria, Belgium and Greece	Not available	Unique value for working and non-working time	Not available	Not available	

5.1.1 Valuing working and non-working time savings – the UK approach

The following paragraphs detail the UK standard approach to the valuation of the working and non-working travel time savings. UK has been chosen as a typical case from developed countries as: UK is one of the few countries in the world where the VOT issues are addressed in a systematic way by conducting a comprehensive "stand alone" study on travel time savings valuation (like MVA/ITS/TSU, 1985) and the concepts and results are subsequently reviewed through another study (HCG & Accent, 1996); concepts and results are well documented and easily available; some spin off studies related to the VOT are also conducted which facilitates an in-depth understanding of the issues related to the VOT. This in-depth

review of the UK approach helps in drawing lessons for VOT research in developing countries.

Working time savings

In the UK working time savings apply only to the time saved while making a journey in the course of work. The UK government standard approach, as stipulated in Department of Transport (1995), is to add an on-cost of 36.5% of the gross wage or salary costs on top of average wage rate. This on-cost represents the overheads such as national insurance, pensions and other costs. Different working time values are suggested for passengers and drivers of different modal groups, like car, bus, rail and underground. Working time saving values differ considerably across different transport modes. For example, the suggested working time value for rail passengers is approximately 50% higher than other public service passengers (e.g. coach passengers). These suggested values are based on the results of National Transport Surveys of 1985/86. An average value of £12.77 per hour (1994 prices) per traveller has been suggested for all workers irrespective of the mode use. The same value has been suggested for waiting, walking and travel in a vehicle. One of the main criticisms of this approach is the assumption of full employment – implicitly assuming that when the time saving occurs, there is additional work for the labour to do (valued at the marginal productivity of labour, proxied by the wage rate) or the labour is released in the market where it is rehired at the existing wage rate. Therefore, the acceptance of wage rate approach in the valuation of working time savings seems to be generous without it is shadow priced to reflect its true resource value.

Non-working time savings

Non-working time value applies to all non-work journey purposes, including travel to and from work places, by all modes. The value of non-working time suggested by Department of Transport (1995) is based on the research conducted in the 1980s by MVA/ITS/TSU (1985) that uses the SP approach in the derivation of values. This study was the first major value of time study undertaken. The suggested in-vehicle time (IVT) resource value by the Department of Transport is £ 3.15 per hour (1994 prices) per traveller, about a fourth of the working time values for all workers. This non-working time value represents the resource value as it is adjusted downward for taxes and subsidies (a reduction of 17.3% has been made from perceived values). The suggested walking and waiting time saving values are double the IVT value. It is also suggested to up-rate both working and non-working time values in proportion to average employee earnings.

One of the main criticisms of a unique non-working time value is that although justified based on equity, it is flawed when considered from an efficiency point of view.

5.2 Developing countries

To date attention has been paid on valuing time in the more economically advanced countries of the world. In cases where specific attention has been paid to valuing time in developing countries, the focus is has been by regular motorised modes generally in an urban or inter-urban context, or the country is at the limits of the term “developing” Again, there is a paucity

of "stand alone" research on valuation of time in rural areas; most estimates have been made as part of an individual appraisal exercise. The estimates are mainly made using the revealed (modified) preference approach and only in a few cases using the SP approach (also modified). The available estimated values of time in developing countries, tabulated in chronological order, are presented in Table 2.

The following are the conclusions after the review of the literature on the valuation of travel time savings in developing countries:

(i) A distinction is rarely made between working and non-working time savings even in the case of urban and inter-urban travel;

(ii) Only in a few cases have preference approaches been used for time valuation; the majority of the approaches involve the use of indirect indicators such as Gross Domestic Product (GDP), wage rates, and Regional Domestic Product (RDP)[14] for the valuation of time. In rural situations, all studies use the indirect RP approach. Again there are two main variants of this approach:

i. The first is to base time values on a common per capita GDP value for all travellers regardless of age, gender or economic activity. Generally the per capita GDP is divided by a nominal number of hours per year, and then the resulting hourly time value is adjusted for trip purpose with the objective of screening out "non-productive" trips[15]. The figure of 2000 is a little higher than the 160 hours per month suggested for developing countries (Gwilliam, 1997). The advantage of the approach is that it is economic and needs surveys only to determine trip purposes if such data are not already available from other studies. As no distinction is drawn between different categories of travellers, it is a more equitable approach as well.

ii. The second is a refinement of the first one and uses the disaggregate income data for travellers. This is calculated from household income and income earner per household, and using different modes of transport. The added attraction of this modified approach is the increasing availability of such data. This is due to a growing concern with poverty, including its measurement and the poverty reduction policies. Modes are assigned to household income levels by transport ownership data from surveys. The hourly time values are adjusted for non-productive trips and shadow wage rates. However, this approach is criticised on the ground of equity.

[14] In some countries data are available on Regional Domestic product (RDP)

[15] A productive trip is any trip the purpose of which is to contribute to the household's productive capacity. In a near-subsistence economy this also includes the provision of household inputs [fuel, water etc.] which would otherwise require a cash transaction.

Table 2: Hourly time values, by mode, 1978-2001 (Values in US$)

Country	Year	Exchange Rate/USD	Per Capita GDP [$]	Car Taxi	LCV 4WD	Bus Mini	Large	Truck	Motor Cycle	Auto Rickshaw	Rickshaw	Bicycle	Pedestrian	Note
Malaysia	1978	6.8	n.a	0.42			0.20							[a]
Brazil	1995	1.00	2419	4.38	2.18	0.87	0.78							[b]
Jamaica	1995	39.62		2.12	0.15	0.55	0.55	0.15						[c]
PNG	1995	1.34	n.a	0.98	0.34	0.22	0.22						0.09	[d]
Ethiopia	1996	6.34	81	0.08	0.08	0.02	0.02							[e]
Kenya	1996	46.20	1500	0.06	0.06	0.05	0.02							[f]
Bangladesh	1997	42.45	220	0.79	0.79	0.23	0.23		0.36	0.13	0.09	0.18	0.03	[g]
Dominica	1997	2.72	2174	0.52	0.68	0.35								[h]
Jamaica	1997	35.00	n.a	2.12	0.15	0.55	0.55	0.15						[c]
Kenya	1998	62.50	1500	0.34	0.48	0.23	0.23	0.64						[f]
Somalia	1998	3800	81	0.10	0.10	0.03	0.03							[i]
Indonesia	1998			5391[16]			2756							[j]
Vietnam	1999	10000		0.11	0.11	0.11	0.11		0.09			0.03	0.02	[k]
Ethiopia	1999	7.30	104	0.10	0.10	0.03	0.03							[e]
Uganda	1999	1475	187	0.07	0.07	0.07	0.07					0.027		[l]
Lesotho	2000	6.00	320	0.30	0.26	0.07	0.03						0.07	[m]
Ethiopia	2001	8.34	105	0.11	0.11	0.03	0.03						0.01	[e]

Notes:

Note	Basis of Estimate	Work Time Included	Non-Work Time Included	Trip Purpose Surveys
[a]	Stated Preference	No	Yes	Yes
[b]	RDP/capita	Yes	Yes	Yes
[c]	Client			
[d]	Wage rates	Yes	No	Yes
[e]	GDP/capita	Yes	No	Yes
[f]	RDP/capita	Yes	Yes	Yes
[g]	Disaggregated Data	Yes	Yes	Yes
[h]	GDP/capita	Yes	Yes	Yes
[i]	As for[e]	Yes	No	No
[j]	Stated Preference	No	Yes	Yes
[k]	Disaggregated Data	Yes	Yes	Yes
[l]	Client/Rural GDP	Yes	No	Yes
[m]	GDP/capita	Yes	No	Yes

[16] Figures in Rupaiya

(iii) Where the travel time valuation involves the use of the SP approach, questionnaires designed following proper experimental design procedures are rare. Generally, an approach close to the "transfer price"[17] approach is used (Thomas, 1983). Also the approach involving a bidding process is not uncommon (Hine, Pangihutan & Rudjito, 1998). The irrational use of SP approach may have produced erroneous results in some cases. This may have resulted in an apparent apathy about the approach among the transport professionals in developing countries (Ministry of Communications, 2001).

(iv) Close observation of Table 2 shows:

i. Different studies come up with widely differing time values. For example, in Brazil the time value of a car/taxi passenger is 362% of the GDP per productive hour[18] compared to Kenya's 45% and Dominica's 48%.
ii. Users of faster and more comfortable modes have higher time values than the users of less efficient modes;
iii. The majority of the studies calculated VOT on the basis of revealed mode use characteristics of the users.

Gwilliam (1997) [19] tried to rationalise the approaches by providing guidelines on the VOT savings, although the suggested values are not based on empirical findings in developing countries.

6.0 RELEVANT ISSUES IN THE VALUATION OF TRAVEL TIME SAVINGS IN THE RURAL CONTEXT OF LDCS

6.1 Relevance of division of time savings into working and non-working classes in the context of rural areas of LDCs

This is one of the main conceptual issues that need resolving in the valuation of travel time savings. This arises as there is a marginal formal employment in rural areas of developing countries. Another question still remains unresolved. Do the working trips need defining differently in the case of rural areas of developing countries in comparison to their developed country counterparts or their urban counterparts?

---

[17] First Proposed by Lee & Dalvi (1969). An estimate of the money value for someone to force from his chosen alternative to next best one. A typical transfer price question is like: how much would the respondent's chosen alternative have to rise in order for the respondents to switch to next best alternative?

[18] Taken as 2,000 hours per year

[19] Latest World Bank guidance (Gwilliam, 1997) on this issue suggested a value of 133% of the wage rate for work and business trip time; and 30% and 15% of household income for non-work trip time for adult and children respectively in all countries. This suggestion is mainly based on the empirical evidences from developed countries and middle income countries.

6.2 Preference approaches in a subsistence context

The values of non-working time savings are assessed empirically using revealed preference of the travellers, or inducing travellers to state their preference, indicators of willingness to pay for their preference. The use of preference-based approaches to valuing travel time savings is viewed with suspicion in the context of the rural subsistence economy. The question is often asked, "how a traveller can attach a cash value to his preference when the use of cash is marginal?" This question is valid in, perhaps, the majority of the rural areas of developing countries.

6.3 Use of SP vs. RP approach for the measurements of WTP

Section 4.0 explains the advantages and disadvantages of the RP and SP approaches. Both the approaches have been tried in one or other form in rural areas of LDCs. However, their systematic applications appear to have been absent if the studies reviewed are considered. In the majority of the cases where the RP or SP approach was adopted, it was applied in a modified form. For example, in all studies where the SP approach was adopted, either the "transfer price" or "bidding process" method was used for time valuation (Lema, 2000, Hine, Pangihutan and Rudjito, 1998). These methods of SP are not generally recommended as they are subjected to strategic biases[20]. On the other hand the RP approach was also used in its modified form – only taking a fraction (depending on the proportion of the "productive" trips made by the occupants of the particular vehicle) of the income of the vehicle owning household as its VOT. Therefore, if the preference approach is suitable at all, which of the two methods is most suitable?

6.4 Non-clarity between marginal value of leisure time and VOT

In some cases, even development professionals mix up the marginal value of leisure time with the VOT (value of travel time savings) and, therefore, try to ascertain the trade-off between income and leisure[21]. As discussed before, there is a difference between marginal value of leisure time and the VOT. While leisure time has marginal value, generally the value of leisure time savings is zero. However, the difference between marginal valuation of time spent on travelling and marginal valuation of leisure time is the VOT or "the value of transferring time." It is conceptually inaccurate to question the productive use of the saved travel time while valuing travel time savings. This valuation simply reflects the traveller's willingness to pay for his/her preference to transfer saved travel time to leisure.

6.5 Perceived values of time vs. resource values of time (or behavioural value vs. resource value)

Although adjustments for taxes and subsidies are made to convert perceived values of non-working time savings to resource values in developed countries, such as in the UK, no such

[20] One of the potential biases of the SP response. It is due to the distortion of valuation of public goods by people to suit their vested interest.
[21] It is often argued that the saved travel time is not used in productive purposes, rather used in leisure, so why attach value to saved time.

adjustments are made in the case of working time savings. This is mainly due to the implicit assumption of full employment and negligible effect of taxes and subsidies on the resource costs. The validity of such assumption is not beyond criticism. However, adjustments (shadow pricing) will be needed for both working and non-working time savings in developing countries to determine true resource values. Adjustments (shadow pricing) for the working time savings – which is linked to the wage rate - are necessary in developing countries. This is due to the existence of unemployment and underemployment, co-existence of formal and informal employment sectors, and existence of tax and subsidies. An adjustment (shadow pricing) for non-working time savings, which represent the willingness to pay to transfer time to leisure that otherwise would have been used on travelling, is necessary to take into account the effects of taxes and subsidies.

6.6 Potential variation of travel time savings

- **Income of the Travellers:** This may be one of the major sources of variation. Indonesian experience shows that the VOT increases with household income but less than proportionally (Hine et. al., 1997).
- **Person type:** VOT may vary with the type of traveller, for example men vs. women, major wage earner vs. non-earner etc.
- **With and without load travel:** This is one of the crucial issues in the rural context in LDCs as significant numbers of trips are made with load, which is irrelevant in developed or middle-income countries' context.
- **Seasonal variation:** Unlike urban areas of developed or developing countries, time values in rural areas are expected to vary in harvesting time, when the family time budget is tight, compared to non-harvesting time. It may also vary in the wet season compared to the dry season.
- **Daily variation:** Another factor that may influence the VOT in rural areas of developing countries is the day of travel – especially market and non-market days.
- **Modal variation:** This type of variation is applicable in developed countries as well as developing countries. Table 2 shows that the VOT differs between modes of transport.
- **Variation due to infrastructure types:** Evidence from Tanzania (Lema, 2000) suggested that there might be a variation of valuation of time depending on the quality and remoteness of the infrastructure from main roads.

STUDY AREA AND METHOD

7.0 SOCIO-ECONOMIC CONTEXT OF BANGLADESH AND THE RESEARCH AREA, JESSORE DISTRICT

The field research was carried out in Jessore District of Bangladesh. This chapter gives a brief background of Bangladesh in general and Jessore District in particular. A map of Bangladesh is given in Map I and of Jessore District in Map II.

Crisscrossed by a large number of rivers and watercourses, including some of the world's largest rivers, Bangladesh is very flat and low-lying. With an area of about 148,393 sq km and population of 129.2 million (2001 census), Bangladesh is one of the most densely populated countries in the world, population density of about 870 persons per sq km. The population is growing at a rate of 1.48 per cent per year (Bangladesh Bureau of Statistics, 2001b). An overwhelming majority of the population of Bangladesh (about 77% as per 2001 census) lives in rural areas. Bangladesh is one of the low income countries in the world. The per capita Gross National Product (GNP) of Bangladesh is calculated at 370 US$. Values added by the agriculture and industries sectors to the GDP are very similar, 25.3% and 24.3% respectively. Bangladesh has a Human Development Index (HDI) value of 0.47, ranked 132 among 162 countries. The HDI index has risen from 0.33 in 1975 to 0.47 in 1999. Some basic facts about Bangladesh are provided in Annex-II.

While the post independence growth performance of Bangladesh was relatively modest with a per capita GDP growth rate of some 2 per cent per annum, the growth performance started to improve in recent years. During the 1996-99 period, per capita income grew by roughly 3.8% (BIDS, 2000). BIDS (2000) reports a slow pace of income-poverty reduction, especially among the rural population, with an extremely slow pace of reduction in the eighties. The proportion of rural population below the poverty line had been reduced at a rate of about 0.8 percent per year between FY 1991/92 and 1995/96. The poverty situation improved further in the late 90s and there has been about 3-percentage points reduction in three years. The latest figure suggests that 44.9 percent of the rural population were below poverty line in May 1999 (BIDS, 2000). Despite relatively slow income growth and modest pace of income poverty reduction, BIDS (2000) identified some noted achievements by Bangladesh in the broader area of human development in last two decades. These include: (i) an impressive reduction in fertility – transition from a "high mortality-high fertility" regime to "low mortality – low fertility regime"; (ii) a reduction of under-five mortality – the current child mortality figure of 92 per 1000 live birth compares with an average of 162 for LDCs, 106 for south Asia; (iii) a considerable decline in child malnutrition in recent years as suggested by child anthropometry; (iv) an impressive progress in the reduction of adult illiteracy and in the expansion of primary education – the adult literacy level had risen to 61 per cent by 1999. Net enrollment rate at the primary level has exceeded 75 per cent, with very little difference in primary enrollment rate between boys and girls. Consequently the adult literacy gender gap is narrowing.

The population census of 1991 suggested that about 41 per cent of rural households were landless[22]. This had increased from some 34 per cent in 1981 (Mahmud, 1996). Just over 30

[22] Those who own no cultivable land

per cent of rural households are classified as non-agricultural according to their major source of income. While about 45% of the households earn their major source of income from direct agricultural cultivation, the major source of income of over one in five household (22.6%) comes from agricultural wages. Although underemployment is very high in Bangladesh, open unemployment is only 0.8% as widespread poverty demands engagement in some form of activity in order to survive. 1990/91 Labour Force Survey (LFS) suggests that approximately 79% of Bangladesh's labour force reside in rural areas (Varma & Kumar, 1996). Despite the dominance of agriculture related employment, non-farm employment is steadily gaining prominence and employs some 38% of the rural labour force as per 1990/91 LFS. While overall employment grew by 3.2 per cent annually between 183/84 and 1990/91, rural employment grew by only 1.9 per cent annually, with non-farm employment registered a growth of 4% per annum. It is difficult to establish the trends in growth in real wages in Bangladesh due to a scarcity of evidence. However, the overall consensus is that the trend of nominal wage growth is not upward, if not downward.

Bangladesh is often discussed as a country divided into four regions - Northern, Southern, Central and Eastern based primarily on the division of the country by the major rivers (Rashid 1977). Quite obviously the rains, the rise and fall of the river levels, floods and changes of river courses form the substance of cultural and physical geography of the country. Ahmed (1995a) divided Bangladesh into following four parts on the basis of transport and topographical characteristics:

(i) **Areas with low river and water density and characterized by the predominance of land transport with or without the existence of water transport**: Cover the majority of the areas of Bangladesh, including major parts of Rajshahi and Khulna Division, part of Dhaka Division and part of Chittagong Division;

(ii) **Areas with moderate river and water course density and characterised by the coexistence of land and water transport**: Include most of Dhaka Division, part of Chittagong Division, and a small part of Rajshahi Division;

(iii) **Areas with high river and water course density and characterized by the predominance of water transport over land transport:** Include most of southern Bangladesh, most of Barisal Division, a small part of Khulna Division and a part of Chittagong Division;

(iv) **Hilly areas characterised by the coexistence of water and land transport except in few extremely hilly areas where land transport modes are almost non-existent**: Include a few small areas of Bangladesh, mainly Chittagong Hill Tracts and a part of Eastern Bangladesh.

Ideally, all the four areas should be covered so that the research findings could represent the whole country with respect to physical, environment and transport characteristics. However, due to time and resource constraints, physical coverage of the study had to be restricted to an area that represents the majority of the country in terms of physical and transport

characteristics. A sample district, Jessore that is characterized by predominantly land transport with only a marginal existence of water transport, was chosen for the study (Map I). In this respect, the study findings do not represent all of Bangladesh, rather they cover majority of the areas in terms of physical and transport characteristics.

Jessore, a south-western district of Bangladesh, is bounded on the north by Jhenaidah and Magura Districts, on the east by Narail District, on the south by Satkhira District and on the west by India. It is situated about 275 km west of the capital city Dhaka. It is connected to Dhaka by land and air routes with travel times of about 6-7 hours by bus and 35-45 minutes by air from Dhaka.

Jessore District has a population of 2.44 million with over 80% of households in rural areas and an average household size of 4.60 as per population census of 2001 (Bangladesh Bureau of Statistics, 2001). About 29% of the households of this District are non-farm households (below 0.05 acres of land) and about 35% own less than 1.00 acre (BBS, 1999). Agriculture is the main source of household income in Jessore district – there is a variation between Upazilas[23], the range is 43% to 77% (BBS, 1996). The overall literacy rate for residents of "7 years and over" in this District is about 33.4% (41% male and 34% female) (BBS, 1996).

Land distribution among different households is highly skewed in Jessore. Rice, wheat, vegetables and oilseeds are the major crops grown in this District, with vegetables being one of the main sources of cash income for the farmers. A considerable portion of the vegetables produced in Jessore is sold in the capital city, Dhaka. Jessore is the second highest *Aus* (Spring-Summer rice) producing district. The cropping intensity of this District in 1998-99 was 195% against a national average of 175 (Bangladesh Bureau of Statistics, 1999). This means that roughly two crops are produced on an average piece of agricultural land.

All types of land transport operate in the rural areas of this District. Bicycle and rickshaw van[24] are the modes used most extensively. Buses generally serve the areas with good access. Although bullock carts play an important part in some areas, especially those with poor road access, anecdotal evidence suggests that their number is declining.

[23] An administrative unit in Bangladesh. The administrative hierarchy in Bangladesh in order of size is Division, District, Upazila, Union and Mauza.

[24] General trend in rural Bangladesh is that the rickshaws are being replaced by rickshaw vans because of their operational flexibility and efficiency. A van is equally suitable to carry loads as well as passengers due to its higher strength wheels and open body structure.

8.0 RESEARCH METHODOLOGY

A combination of quantitative and qualitative approaches was undertaken to achieve the study outputs and purpose. The qualitative data helped in explaining and strengthening the findings from quantitative data analyses. The qualitative approach also provided an overview of the features of rural households and their economic and social choices. This was used for adapting the theoretical model on which the valuation of travel time methodologies was based. The following sections detail the qualitative and quantitative approaches undertaken.

8.1 Qualitative approach

While the core of this study is concerned with testing the applicability of quantitative methodologies for estimating the value of time, a qualitative assessment of the rural socio-economic context was considered to be an essential component of the study. The qualitative approach involved focus group discussions and case studies of selected individual travellers. The purpose of focus group discussions was to obtain an overview of: (a) the main economic activities and socio-economic conditions in the study areas and (b) socio-economic characteristics of typical relatively better off, medium-income and poor households.

The insights on local socio-economic conditions provided by the qualitative approach combined with rigorous quantitative analysis enables a better understanding of issues and more confidence in the research results (Carvalho and White, 1997). Focus groups are one of the means of drawing on local knowledge and perspectives. Apart from providing a general overview of socio-economic conditions, information obtained from the two focus group discussions (see Annex-III for a summary) was used for identifying possible indicators of household income levels for inclusion in the household survey questionnaire (see section 9). The main issues discussed in the groups were:

a. the main problems affecting living conditions in the area;
b. the main ways in which people make a living;
c. the relative pay and status of different occupations; and
d. characteristics of “rich”, “average”, “poor” and “very poor” households (how they earn their living, their homes and other assets, what problems they face and how, how often and why they travel.

There were two main focus group discussions, one each in the two RP and SP study locations. The first group in Chanchra Union on the Pulerhat to Rajganj road was arranged through the Union Council Chairman. The purpose of the group meeting was explained to the Chairman and a request was made for a group of about 10 persons (including 4 women) representing the relatively well off, average and poor households. At the outset of the meeting, there were 14 persons, which was too big a group for full participation by all members, though some people left during the early stages of the meeting and during the rest of the meeting when the most substantial issues were discussed, there were 8 persons including the three women. Although some two or three persons within this group were identified as representing the poorer people

in the area, the majority seemed to be from average to better off farming households with other occupations.

The second was an impromptu discussion with local people at the end of a market day in Bandbilla Union. The discussion was held in front of local stalls where there was a small social gathering of 8 to 10 local farmers and traders (all men) relaxing at the end of the day. An advantage of this arrangement over the first group was that the more relaxed and informal atmosphere led to more open discussion. A clear limitation was that all participants were men. Ideally, a focus group of women conducted by a woman should have been arranged to complement this all male group. This was not possible within the time constraints. Nevertheless, for the type of information that was required from the discussion group and given the other checks (corroboration from the first focus group and the from the household survey data) this limitation was not considered to be serious.

In addition to the focus groups, selected male and female travellers from different social groups were interviewed to understand their reasons for travelling and choice of transport modes and how these were related to their socio-economic circumstances. Discussions were also held with transport operators to crosscheck the findings. The understanding of socio-economic characteristics obtained from the qualitative appraisal and the household socio-economic survey provided the context for interpreting the empirical results on value of time.

8.2 Quantitative approach

The quantitative approach involved 9 types of questionnaires in two broad categories: one household questionnaire administered at the household; and eight Revealed Preference (RP), Stated Preference (SP), and travel purpose questionnaires administered at roadside interviews. Table 3 presents the purpose of each of the questionnaires along with their unit and place of administration. In all cases the questionnaires were piloted before they were fully utilised for the study.

The household, a sample RP, a sample SP and the travel purpose questionnaires are attached in Annex-IV, Annex-V, Annex-VI and Annex-VII respectively. Annex-VIII provides the actual values and choices offered in different SP questionnaires. These values are generated following SP experimental choice design procedures (the step-by-step procedure for experimental design is detailed in Annex-IX):

Table 4 provides the number of different types of questionnaires administered in the two rounds. Apart from household and preference questionnaires, a travel purpose questionnaire was also administered. The objective of the travel purpose questionnaire was to supplement the travel purpose data already collected as a part of the preference data in order to understand the purpose of travel by the respondents (details shown in Table 3)

Table 3: Types of questionnaires used in the study

Questionnaire	Application Unit (Place of Administration)	Collected Data on	Objectives
Household Questionnaire	Household (at the household)	Basic household information, income and expenditure data, and activity data	To identify variables those significantly explain the household expenditure. These variables are used in preference questionnaires for estimating the household expenditure that is subsequently used for poverty analysis. Evidence from the activity diaries is used for analysis of time-use patterns of different social and gender groups.
RP Questionnaire	Individual traveller (roadside)	Basic personal and household information, travel attributes and revealed choice data	To value bus, rickshaw van and other vehicles in-vehicle time (IVT) and walking time values for passengers from all modes.
SP Questionnaire 1	Individual traveller (roadside)	Basic personal and household information, travel attributes and stated choice data	To value IVT for bus passengers travelling on an improved road including the value of travel time savings under un-comfortable travelling conditions.
SP Questionnaire 2	Individual traveller (roadside)	As above	To value bus and rickshaw van IVT values for rickshaw van passenger travelling on a non-improved road.
SP Questionnaire 3	Individual traveller (roadside)	As above	To value bus IVT and walking time values for bus passengers on an improved road.
SP Questionnaire 4	Individual traveller (roadside)	As above	To value bus and rickshaw van IVT values for rickshaw van passengers travelling on an improved road.
SP Questionnaire 5	Individual traveller (roadside)	As above	To value rickshaw van IVT and walking time values for rickshaw van passengers on a non-improved road.
SP Questionnaire 6	Individual traveller (roadside)	As above	To value bus IVT and walking time values for pedestrians on a non-improved road.
Travel Purpose Questionnaire	Individual traveller (roadside)	Travel attributes including travel purpose	To supplement travel purpose data already collected as a part of the preference data in order to understand the purpose of travel by the respondents.

Table 4: No of questionnaires administered in different rounds

	Number of Questionnaire Administered		
Questionnaire	**Round 1 (Wet Season)**	**Second 2 (Dry Season)**	**Total**
Household Questionnaire	92	N/A	92
RP Questionnaire	269[25]	515	784
SP Questionnaire 1	140	179	319
SP Questionnaire 2	120	126	246
SP Questionnaire 3	121	127	248
SP Questionnaire 4	120	125	245
SP Questionnaire 5	120	124	244
SP Questionnaire 6	120	125	245
Travel Purpose Questionnaire	751	N/A	751

[25] A total of 333 questionnaires were administered but only 269 were found useable.

RESULTS OF THE STUDY

9.0 SOCIO-ECONOMIC CHARACTERISTICS AND TRAVEL PURPOSE

Household surveys were conducted alongside two roads where the preference questionnaires were administered subsequently. These roads are Pulerhat to Rajganj via Goalda Bazar road in Jessore Sadar Upazila and Naricalbaria to Gaidghat road via Khanpur in Bagherpara Upazila (Please see Map II for location and Annex-X for descriptions). Alternate households along the road corridor were selected and interviewed using a pre-defined questionnaire (Annex-IV). Information was collected on households' basic parameters (e.g. household size and composition, type and size of household dwellings, land ownership, type and amount of crops produced etc.) and economic (occupation of the household's main earner and details on income and expenditure) characteristics. Collection of income and expenditure data at the same time provided opportunities for the enumerators to check any inconsistencies in the reporting by the respondents and for subsequent correction. Information on different agricultural items produced by the household themselves helped in the estimation of the amount of produce consumed in kind by the household – i.e. the difference between amounts produced and sold. Information was also collected on the activities performed by two active household members – a male and a female over the age of 16 and below the age of 60 – the day before the interview using an activity diary. Similar information was also collected for a typical day during the busy time of the year –during the harvesting/planting season - from recollection[26]. Household questionnaire survey information mainly served two purposes:

- To identify indicators and to estimate their coefficient values for differentiation of the households on the basis of their economic status. These indicators are subsequently used in the preference questionnaires to differentiate the responding travellers on the basis of their social classes; and

- To identify the activity patterns of different gender and social classes.

Household socio-economic and activity data were collected from a total of 92 households - 42 and 50 households along Pulerhat to Rajganj Road and Naricalbaria to Gaidghat Road respectively[27]. In total 181persons were interviewed from these households for activity data of whom 91 were men and 90 were women.

The following section presents the results of the econometric analysis for the identification of the indicators that significantly explain the household consumption expenditures and estimation of their coefficient values. Section 9.2 presents the results of the analysis of the activity data for identification of activity patterns.

[26] July-August is considered as a non-busy time of the year in Jessore as there is no major harvesting or planting activity at this time of the year.

[27] Although data were collected from a total of 100 households – 50 each from two roads – 8 household questionnaires were found unsuitable for use due to poor response from the respondents along Pulerhat – Rajganj Road corridor.

9.1 Identification and estimation of the indicators for differentiations of households on the basis of economic status

Evidence from developed countries strongly suggests that the value of travel time savings is a function of household income. It is logical to expect that a member of a household with higher income would be willing to pay more to avoid the inconvenience of longer travel. Although it is true that longer travelling time is as inconvenient to low-income people as to their high-income counterpart, the high-income travellers can afford to pay to avoid such inconvenience. Therefore, there is a need to differentiate households on the basis of their economic status so that such differentiations can be used when modelling the valuation of travel time saving. However, unlike developed countries or urban areas of developing countries, assessing someone's personal or household income from a roadside interview is difficult. This is due to two reasons: a majority of the rural household in LDCs earn little cash income as they are engaged in subsistence agriculture unlike their developed country or urban counterparts and, secondly, there is a general reluctance to reveal income directly to outsiders. To overcome these problems, the household income/ expenditure survey was conducted before the main roadside preference survey to develop an econometric model with indicators that significantly explain the households' per capita consumption expenditure. These indicators and their coefficient values were subsequently used in the roadside survey questionnaires to estimate the households' income. This method was found convenient, as the respondents did not feel threatened when revealing this information.

At the beginning, total consumption expenditures of the households per year were calculated using per year cash expenditure information and the amount of consumption in kind[28]. This helped in establishing the same treatment of households that are dependent on subsistence agriculture as those that are integrated into the market agriculture. This is then used for calculation of per capita consumption expenditure[29] using household size information.

These per capita consumption expenditures[30] along with other collected household information are used in the econometric analysis for the development of an econometric model. The following equation provides the basic form of the model:

$$PERCAPEXP : \sum \alpha_i * X_j + \sum d_m * \beta_m \ldots\ldots\ldots \text{(i)}$$

Where: PERCAPEXP = Consumption expenditure per capita per year for the household; X_j = Continuous dependent variable j (e.g. amount of land per capita, no of members involved in income earning activities etc.) ; d_m = Dummy for dependent variable m (e.g. whether any

[28] Amount of consumption in kind is calculated by subtracting total agriculture produce sold from total amount of agriculture production.

[29] Total household consumption expenditure seems to be an unsatisfactory measure. A small household with lower income may be better off in terms of per capita well being compared to a large household with higher income.

[30] Consumption is preferred over income as consumption is considered a more stable indicator compared to income. The latter may be subjected to many transitional influences (Khan and Sen, 2001). Conversely, it is also argued that income is better than expenditure, as expenditure may be unstable in the case of poor households that finance expenditure by liquidation of household assets, which is unsustainable.

household member is involved in a permanent job etc.; yes = 1 and no = 0); and α_i and β_i= are coefficients.

The detailed analysis results are given in Annex-XI. Table 5 presents the significant variables along with their coefficients in the chosen model. The final econometric model for prediction of per capita consumption expenditure is shown in Equation ii.

Table 5: Independent variables and their co-efficients

Independent Variable	Coefficient
Land Per Capita (Acres) [LANDCAP]	440
No of person involved in income earning activities in the household [NO_INCOME]	3813
Dummy for household owning motorised transport including motorcycle (Yes=1, No=0) [D_M_TRAN]	12215
Dummy for any member of the household with permanent job (Yes=1, No=0) [D_P_JOB]	5758
Dummy for any member of the household with established business (Yes=1, No=0) [D_P_BUSI]	3474

PERCAPEXP = 440 *LANDCAP + 3813 * NO_INCOME + 12215*D_M_TRAN + 5758 * D_PER_JOB + 3474 * D_PER_BUSI ……..(ii)

The analysis results appear to be in conformity with the findings of the participatory appraisal using focus group discussions (Box 1).

Box 1: Distinguishing Typical Better-Off, Medium-Income And Poor Households as Perceived by People in the Area

- **Land Ownership**: Better-off households are likely to own 1.5 acres or more of land per person. Average income households would typically have less land per person (between 0.5 to 0.6 acres per head). Poorer households are likely to have much less land or even no land and their members would therefore need to look for casual work. However, some of them (for example female headed or elderly households with small amounts of land) may also have to hire workers for farming during harvesting.
- **Businesses and Jobs**: Better-off households are likely to have more profitable businesses such as fish hatcheries or members of households with permanent well paid jobs. An average income household may run a small business earning about 50 to 60 Tk per day. Operators of rickshaws and vans on rural roads were often from the poorer sections of the population.
- **Size of Houses and House Construction Material**: They are visible indicators of the wealth of households (for example, richer households typically had relatively large houses of permanent construction with brick walls and a tin roof). However, this is not always a good indicator. There were examples of families who had sold their land to raise the funds to build a better house for social reasons (for example, to raise their status to improve marriage prospects for daughters).
- **Vehicle Ownership**: Ownership of a motorised vehicle, typically a motorcycle, is clearly identified as an indicator of the wealth of a household

9.2 Defining the threshold per capita income for poor and non-poor travellers

Consumption expenditure levels of households have been chosen in preference to income levels as a basis for assessing poverty incidence in this study given their advantages that are explained above. Depending on the methodology adopted and assumptions made, there could be a number of approaches for assessing the poverty incidence of a country. Detailed discussion of different approaches and examination of all poverty incidence estimates for Bangladesh are beyond the scope of this study. Two approaches - standardised international poverty level thresholds and the cost-of-basic-needs – commonly used in Bangladesh for assessment of poverty incidence, are discussed in this section and the suitability of their use in this study is assessed.

As per international poverty level thresholds, a person is said to have fallen below lower and higher poverty thresholds if the person's income per day is below US$1 and US$2 respectively, after adjusting for Purchasing Power Parity (PPP). These figures of US$1 and US $2 are based on 1985 PPP estimates. The most recent recalculation available is for 1993. This suggests figures of US$1.08 and US$2.15 for higher and lower poverty lines respectively (World Bank, 2001a). However, to convert these figures into local currency, they need to be multiplied by a factor to represent the equilibrium real exchange rate. Such a factor is calculated using the following steps:

(i) First the factor to convert the nominal value to PPP value in US$ term is calculated using the latest available Gross National Income (GNI) figures in nominal (US$47.1 billion) and PPP (US$196 billion) values (World Bank, 2001a). The calculated factor is 4.135; and

(ii) Then the factor for converting the nominal value in US$ to PPP value in local currency (Taka or Tk) is calculated by dividing the nominal exchange rate of US$ to Tk (1 US$=57 Tk) and the factor for converting nominal value to PPP value (4.135). The calculated factor is 13.785.

This factor of 13.785 is used for converting US$ to Tk in PPP terms. The values of higher and lower threshold poverty lines are calculated at Tk 5,434 (US$1.08 level) and Tk 10,817 (US$ 2.15) per person per year respectively.

An alternative, and arguably more precise, approach to assessing poverty incidence is the cost-of-basic-needs (CBN) method in which the cost of a bundle of products defined as providing a minimum for an adequate standard of living is estimated. The income or expenditure of households is then compared against it to estimate poverty incidence. An advantage of this approach is that it makes it possible to take account of differences in price levels and poverty levels between different areas, for example between urban and rural areas and between different rural areas. BIDS (1998) provides recent estimates of rural poverty lines using the CBN method and these estimates have been used in the assessment of poverty incidence. BIDS (1998) sets out a normative minimum consumption bundle of food items and a minimum expenditure on non-food essentials to define the poverty line. The actual line

defining the minimum expenditure required for each locality was determined by estimating the expenditure at prices in the locality. This resulted in different poverty lines for different villages, based on different consumption bundles, ranging from Tk 6369 to Tk 5573. The higher values were for villages close to Dhaka, capital city of Bangladesh, and therefore not appropriate for rural areas in Jessore District. The latter value, therefore, seems to be more appropriate. However, this is not considerably different from the calculated value of Tk 5434, the lower international threshold poverty line value.

To facilitate the international comparison of the study results, the two threshold values calculated at Tk 5,434 and Tk 10,817 are used in this study. On this basis, the results of the household survey show that in the study area 53 per cent and 81 per cent of the households fall below the $1 and $2 international poverty thresholds respectively.

9.3 Time budget analysis

As mentioned in Section 9.0, information was collected on activities performed by two active members of the household – a male and a female over the age of 16 and below the age of 60 – on the day before the interview using an activity diary as a part of the household survey. Similar information was also collected for a typical busy day of the year – during the harvesting/planting season. This was achieved by requesting the respondents to answer from recollection. The objective of collecting such information was to identify the activity patterns of different social and gender groups in different seasons.

Table 6 presents the average time spent by the respondents for different purposes disaggregated into gender and social groups. The following can be concluded from Table 6:

- Apart from sleep, both poor[31] and non-poor men spend most time in the day for work - poor men even spend more time for work than sleep during the busy season. Both poor and non-poor women spend more of their available time in performing domestic tasks than any other activity[32].

- Average sleep time for the poor is higher than the non-poor – both on normal as well as on busy days (7.8 hrs against 7.5 hrs and 7.4 hrs against 7.1 hrs respectively). This is true for men as well as women. This may be explained by the fact that poorer people are involved in more physically demanding jobs than their non-poor counterparts and, therefore, need more sleep.

- Average time for social and leisure activities for the poor is lower than their non-poor counterparts – both in normal as well as in busy seasons (1.7 hrs against 2.4 hrs and 1.0 hrs against 1.7 hrs during normal and busy seasons respectively). This is true for both men and women. An average poor woman only spends some half

[31] Respondents below household per capita income of 5,434 Tk

[32] To capture the work within household and outside household work has been differentiated into two types domestic tasks (activities related to household work, like cooking, water collection etc.) and work (activities which are directly related to earning or production, like paid works, crop production, business etc)

of the time in social and leisure activities compared to the time spent in social and leisure activities by her non-poor counterpart during the busy season;

- When sleeping time and social and leisure time are combined, an average non-poor person spends more time compared to an average poor person - 9.9 hours against 9.5 hours and 8.8 hours against 8.4 hours in normal and busy seasons respectively. This is true for both men and women;

- An average poor respondent spends more time in work than their non-poor counterpart, both on normal and busy days – 4.1 hrs against 3.8 hours and 4.7 hrs against 3.5 hours respectively. This is also true for males. However, an average poor woman tends to spend less time for work compared to her non-poor counterpart in normal times of the year;

- An average poor respondent spends less time for domestic tasks compared to their non-poor counterpart during normal times of the year. An average poor woman spends more time in domestic tasks than her non-poor counterpart, both in normal and busy times of the year. However, an average poor man tends to spend less time in domestic tasks than his non-poor counterpart.

Table 6: Average time (hours) spent by the respondents for different purposes

		Sleep		Social and Leisure		Sleep and Social and Leisure		Work		Domestic Work	
		Normal	Busy	Normal	Busy	Normal	Busy	Normal	Busy	Normal	Busy
Men	Non-Poor[33]	7.6	7.1	2.3	1.8	9.8	8.9	7.0	6.8	1.9	3.8
	Poor	8.0	7.6	1.6	1.1	9.6	8.8	7.9	8.9	1.1	1.8
Women	Non-Poor	7.4	7.1	2.6	1.6	9.9	8.7	0.6	0.1	9.2	11.3
	Poor	7.6	7.3	1.8	0.8	9.4	8.1	0.3	0.4	10.1	11.6
Overall	Non-Poor	7.5	7.1	2.4	1.7	9.9	8.8	3.8	3.5	5.5	7.5
	Poor	7.8	7.4	1.7	1.0	9.5	8.4	4.1	4.7	5.6	6.7

To test the statistical significance of the above observations, t-tests for the equality of means were conducted and the summary results are presented in Table 7.

[33] Below per capita expenditure of $1 PPP a day

Table 7: Results of the t-test for equality of means between poor and non-poor (2-Tail Significance)

	Sleep		Social and Leisure		Sleep and Leisure Social		Work		Domestic	
	Normal	Busy	Normal	Busy	Normal	Busy	Normal	Busy	Normal	Busy
Men	0.011[34]	0.001	0.009	0.008	0.415	0.768	0.295	0.299	0.154	0.031
Women	0.146	0.139	0.042	0.004	0.146	0.090	0.330	0.116	0.122	0.483
Overall	0.001	0.005	0.002	0.000	0.097	0.140	0.678	0.134	0.962	0.337

The conclusions from Table 7 are:

- The time of sleep for an average poor person is significantly higher than their non-poor counterpart. This is also true for an average poor man. However, the time of sleep for an average poor woman is found not to be significantly different from that of her non-poor counterpart;

- An average non-poor person spends a significantly higher time for social and leisure activities compared to an average poor person. This is true for an average non-poor man and an average non-poor woman;

- In other cases (time for work, domestic work and sleep, social and leisure combined) no significant differences were found between an average poor and an average non-poor person. This is true for both an average man and an average woman.

9.4 Analysis of travel purpose

One of the expected outputs of the study is that the null-hypothesis: "work and non-work journeys for rural residents in LDCs can be differentiated," is tested. In order to achieve this, the journey purpose information was collected while administering preference questionnaires. However, it was felt that this may not be sufficient to draw valid conclusions due to the fact that: preference questionnaires were administered only on two categories of roads (Feeder Road Type B (FRB) and Rural Road Type 1 (R_1) [35]) omitting some lower categories of roads; and they were administered only when the respondents agreed to respond to a relatively long questionnaire. An additional travel purpose survey was conducted on all four categories of rural roads irrespective of modes use using a brief questionnaire (Annex-VIII) with the

[34] Where the significance is less than 0.05, the hypothesis of equality of means can be rejected, i.e. the difference between the poor and non-poor groups is significant.

[35] The classified rural road hierarchy in Bangladesh in order of classification is Feeder Road Type B, Rural Road Type 1, Rural Road Type 2 and Rural Road Type 3. Below these categories there exist paths and tracks. For details on road classification see World Bank (1996).

adoption of a systematic approach[36]. These roads are: (i) Bakhra - Bagachra Road (FRB) in Jhikargacha Upazila; (ii) Bagerhat - Kamalpur road (R_1) in Sadar Upazila; (iii) Shadipur – Sheordah road (Rural Road Type 2 (R_2)) in Jhikargacha Upazila; and (iv) Lebutala - Paranpur road (Rural Road Type 3 (R_3)) in Sadar Upazila. The locations of the roads are shown in Map II and descriptions of the roads are provided in Annex-X. This travel purpose information along with the information collected through preference survey questionnaires were pooled together for analysis.

Table 8 and Figure 1 present the overall and gender disaggregated purpose for travel under three broad categories. It can be seen from the table that approximately three in four trips are made to meet household's wider socio-economic needs and one in four for social and leisure purposes respectively. Only a small proportion of trips are made for household basic needs on these types of road (0.5%). This was expected as most travel for basic needs is on unclassified tracks and paths much closer to homes. There is a difference in the split between the categories for men and women, with a larger proportion of the women's travel being for social and leisure purposes, which includes meeting social obligations

Table 8: Overall and gender disaggregated purpose for travel

Overall (n = 1492)	Nos	%
Household Basic Needs[37]	7	0.5%
Household Wider Socio-Economic Needs[38]	1,110	74.4%
Social and Leisure[39]	375	25.1%
Overall male (n = 1222)		
Household Basic Needs	6	0.5%
Household Wider Socio-Economic Needs	957	78.3%
Social and Leisure	259	21.2%
Overall female (n=270)		
Household Basic Needs	1	0.4%
Household Wider Socio-Economic Needs	153	56.7%
Social and Leisure	116	43.0%

[36] Respondents were sampled on the following basis: one in every three pedestrians; all bus passenger; one in every two rickshaw van or bicycle passengers and all other passengers.

[37] Travelling in relation to households' basic needs. This includes travelling in relation to basic household activities (like water collection, firewood collection, grain grinding) and basic agricultural activities (ploughing, planting, weeding, harvesting)

[38] Travelling in relation to households' wider socio-economic needs. This includes, amongst others, travelling for access to socio-economic facilities (like markets, economic institutions, educational institutions, health centres etc.), commuting, work related travel etc.

[39] Travelling for social and recreational purpose (like visiting friends and relatives, going to cinema, theatres etc.)

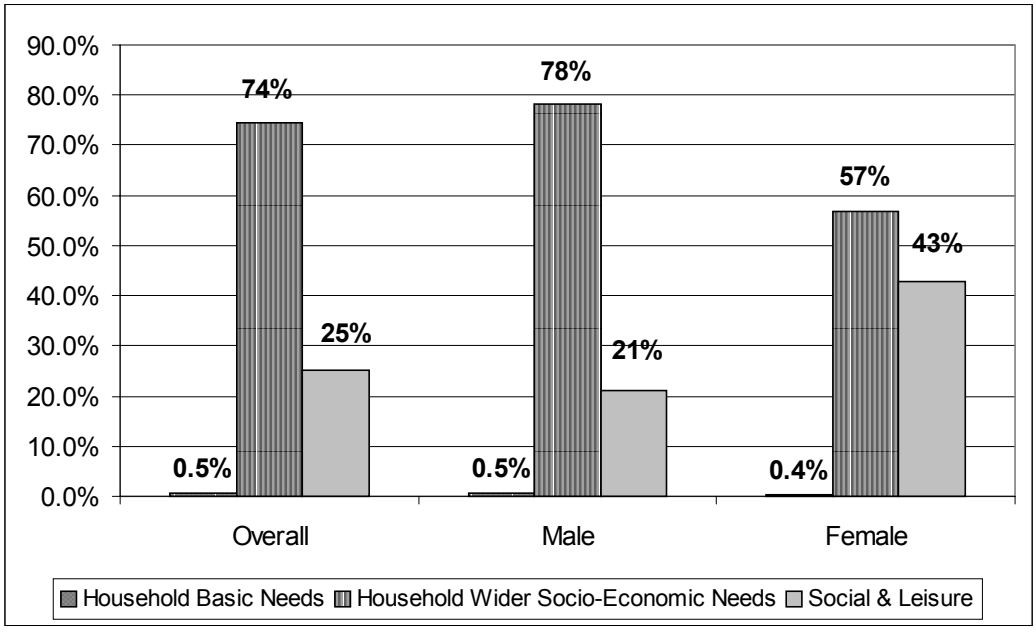


Figure 1: Overall and gender disaggregated purpose for travel

When the travel purpose information is disaggregated among different road types no distinct pattern emerged on the purpose of travel on different road categories (Table 9). The proportion of travel for households' basic needs, households' wider socio-economic needs and social and leisure purpose range from 0-0.9%, 64.5-79.5% and 23.5-35.5% respectively.

Table 9: Reported main purpose of travel on different types of roads

Road Type	Travel Purpose (overall n=1492)	Nos	%
Feeder Road Type – B	Household Basic Needs	1	0.2%
Feeder Road Type – B	Household Wider Socio-Economic Needs	366	76.6%
Feeder Road Type – B	Social and Leisure	111	23.2%
Rural Road Type 1	Household Basic Needs	6	0.9%
Rural Road Type 1	Household Wider Socio-Economic Needs	522	75.9%
Rural Road Type 1	Social and Leisure	160	23.3%
Rural Road Type 2	Household Basic Needs	0	0.0%
Rural Road Type 2	Household Wider Socio-Economic Needs	62	79.5%
Rural Road Type 2	Social and Leisure	16	20.5%
Rural Road Type 3	Household Basic Needs	0	0.0%
Rural Road Type 3	Household Wider Socio-Economic Needs	160	64.5%
Rural Road Type 3	Social and Leisure	88	35.5%

Table 10 presents the disaggregated purpose of travel under "households' wider socio-economic needs" category. Overall, "For going and coming from work place", "For purchase/selling of goods for profit", "Travel to go to market for purchase (not for profit)"

and "Household wider agricultural needs" are the largest categories and between them account for about 74% of all "wider socio-economic trips". Only 1% of the trips were made while working under an employer – the so-called working trips as defined in the developed country context. There is a substantial difference between the travel purpose of men and women, with the largest proportion of trips for the former being "for purchase/selling of goods for profit" followed by "for going and coming from work place." In the case of women, the largest proportion of trips were made "for going and coming from work place" followed by "for travelling to health facilities" and "for going to market for purchase (not for profit)". The reason for women travelling to health facilities being higher than for men is, perhaps, that women's responsibilities extend to children as well.

Table 10: Disaggregated travel for wider socio-economic needs

Wider Socio-Economic Needs	Overall		Male		Female	
	No	%	No	%	No	%
Household wider agricultural needs	119	11%	117	12%	2	1%
For going to economic facilities (e.g. banks)	6	1%	6	1%	0	0%
Travelling while work under other employer	12	1%	11	1%	1	1%
Self employed travelling while working	43	4%	39	4%	4	3%
For going and coming from work place	237	21%	186	19%	51	33%
For purchase/selling of goods for profit[40]	264	24%	254	27%	10	7%
Travel to go to health facilities	66	6%	46	5%	20	13%
Travel to go to market for purchase (non-profit)	203	18%	183	19%	20	13%
travel to go to town	31	3%	27	3%	4	3%
Travel to go to administrative centres (e.g. Upazila HQs, District HQs government offices, post office etc.)	32	3%	31	3%	1	1%
Travel to go to Educational institutions	97	9%	57	6%	40	26%

In the conventional analysis of value of travel time in industrialised countries, a distinction is made between work and non-work trips. Table 10 shows that from the Bangladesh field studies only 1% of the trips can be considered as working trips if the conventional definition if followed. The proportion rises to 5% if the trips made by the self-employed during work is also considered. Trips made for the purpose of buying/selling of goods for profit constitute a substantial proportion of the trips, 24%, made for wider socio-economic needs. Varma (1996) reports that due to the non-availability of land and the relative stagnation of agriculture, rural workers are increasingly being attracted towards Rural Non-Farm (RNF) employment, with trade and shop keeping being the most important non-farm occupations, followed by services and construction. Retail trade activities, like trade in groceries, textiles, furniture, hardware etc., account for 72% of all employment in trade (Varma, 1996). Under such circumstances it is not surprising that a sizeable proportion of the trips were made for the purpose of purchase/selling goods for profit. If this category of travel is included under the working trip category, then working trips constitute roughly 30% of trips made for the purpose of wider socio-economic needs. In overall terms, they constitute some 21% of all trips. The counter

[40] Like a shopkeeper going to a market for purchase of goods or a petty trader going to a market for selling of goods.

argument of non-inclusion of trips made for the purpose of purchase/selling of goods could be that this should be treated as non-working trips as they are similar to commuting trips. However, it is more justifiable to include these trips under the category of working trip, as the opportunity cost of lost time while travelling might be equal to the marginal value of income of the particular traveller.

Therefore, although a marginal number of trips (1%) can be categorized following the conventional developed country definition of working trip, the value of travel time saving for about 21% should be made at least equal to the wage rate of the traveller[41].

One of the complexities in assessing the value of travel and travel time for rural travellers is thought to be that their trips often have multiple purposes (for example, combination of an economic purpose such as taking produce to the market and leisure). Table 11 and Figure 2 show that in the Bangladesh field study only 14% of all trips had a secondary purpose, with a much smaller proportion (3%) of leisure trips having a secondary purpose. These findings seem justified if rural residents' trip patterns as established by Ahmed (1997) are considered. Rural residents in Bangladesh makes higher number of trips compared to their African counterparts. An average person in rural Bangladesh makes approximately 8.5 trips per day. Dawson and Barwell (1993) provide comparable figures of just over one trip per day in Tanzania and Ghana. An average trip time for a rural resident in Bangladesh is just 8.4 minutes and an average trip length is 0.8 km (Ahmed, 1997). Again an average male makes less frequent (7.2 trips per day) but longer trips (an average trip length of 13.2 minutes) than an average female – 9.3 trips per day with an average trip time of 4.7 minutes). However, such findings may be unique to Bangladesh with a high population density and short distance to facilities and services.

Table 11: Overall response on secondary purpose of trip

Main Travel Purpose		Overall		Male		Female	
	Secondary Purpose?	Nos (n=1492)	%	Nos (n=1222)	%	Nos (n=270)	%
Overall	Yes	207	14%	193	16%	14	5%
	No	1285	86%	1029	84%	256	95%
Basic Household Needs	Yes	1	14%	1	17%	0	0%
	No	6	86%	5	83%	1	100%
Households' Wider Socio-Economic Needs	Yes	193	17%	184	19%	9	6%
	No	917	83%	773	81%	144	94%
Social and Leisure	Yes	13	3%	8	3%	5	4%
	No	362	97%	251	97%	111	96%

[41] The concept of on-cost on top of the wages is invalid in case of rural areas of Bangladesh due to the near non-existence of western style formal employment.

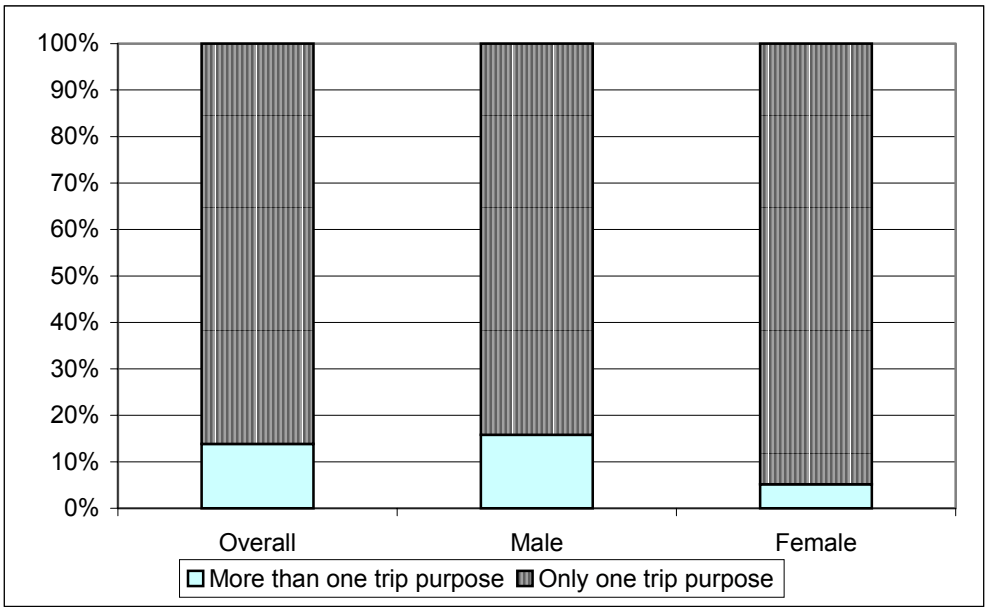


Figure 2: Proportion of single and multiple trip purpose

10.0 VALUES OF TRAVEL TIME SAVING AND SUITABILITY OF ALTERNATIVE APPROACHES

Section 8.2 explains the types of preference questionnaires used in this study along with the objectives of their use. A total of 7 types of preference questionnaires were used in the study – 6 types of SP questionnaires and one RP questionnaire. Models were developed using the Hierarchical Logit (HL) modelling concept and adopting simultaneous equation methods. Details of the data analysis strategy and models estimation procedures are provided in Annex-XII. Table 12 presents the results of the preferred models from separate SP and RP analyses, and combined RP and SP analysis from both rounds of data (wet season and dry season). Annex-XIII presents the coefficient values and corresponding t-values of the chosen models.

Table 12 shows that the base value of in-vehicle travel time for men ranges from 4.75 to 7.64 Tk/hour and for women from 2.25 to 7.64 Tk/hour respectively. The average base values for men and women range from 3.5 to 7.64 Tk/hour. Based on the data collected, a separate estimate for bus travellers and rickshaw van travellers could not be made. In one case, the result of analysis of RP data only, the walking time could also not be calculated separately as its coefficient becomes insignificant when treated separately.

The average values of walking time savings were found to be about 12% and 9% higher than the average IVT base values in cases of separate SP analysis and joint SP and RP analysis respectively. Market day travel attracted some 42% and 37% higher values than the base IVT values respectively in case of separate SP analysis and in case of RP and SP joint analysis. There was no significant difference in time saving values between market and non-market day travel in the case of the separate RP data analysis.

Male travellers had about double the time saving values of their female counterparts – both in cases when the SP data were modelled separately and modelled jointly with RP data.

The willingness to pay by the major non-farm earners[42] was found to be considerably higher than their non-earner counterpart – more than four times the average base values. In no instance did travel time savings for non-essential (social and leisure) trips have significantly different values to other (essential) trips. Travelling with loads attracted higher time saving values, approximately 14% and 15% higher values than average base values when SP responses were treated separately and SP responses and RP data were combined together.

Poor travellers were found to have higher values than their non-poor counterparts – some 9% higher values. This was the case both for the combined SP and combined SP and RP analyses. In the case of the separate RP analysis, the time saving value of poor travellers was found to be very much higher. Willingness to pay while travelling on a poor road compared to a good road was not found to be significantly different in the cases of the combined SP and the combined RP and SP analyses. However, in the case of analysis with RP data, the WTP for travelling on a poor road was more than double (108% higher) the base time value. None of the models show any significant difference in the value of travel times between travelling in the dry season and wet season.

Table 12 and Figure 3 show that the separate analysis of RP data failed to return a good model with reasonable base in-vehicle and additional attribute time saving values. Therefore, the results from RP analysis are discarded from the subsequent discussion. The reasons for problems with RP data are discussed separately below. The results of the analyses of SP data and RP and SP data taken together, including the goodness of fits (Rho square values), are not very different from each other. The combined SP model has therefore been chosen for discussion purpose and time values from this model are discussed in the following section[43].

[42] Includes government employees, permanent or temporary jobs, teachers, construction businessmen, large traders

[43] The RP and SP data are usually modelled jointly under the assumption that the RP data is of superior quality and, therefore, the joint model can be benefited from the RP data. However, in the case of this study the RP data is found to be of doubtful quality (discussed later). Hence the combined SP model is preferred over the combined RP and SP model.

Table 12: Summary of the chosen models and estimated values of travel time savings

	Combined SP (Round-1&2)	Combined SP & RP	RP only
Base Value of Travel Time Savings (Tk/hr)			
IVT bus	**	**	**
IVT rickshaw van	**	**	**
IVT (male)	4.75	4.82	7.64***
IVT (female)	2.25	2.29	
IVT (average)[44]	3.50	3.55	
Walk (male)	5.16	5.14	***
Walk (female)	2.66	2.61	***
Walk (average)	3.91	3.87	***
Additional Value (Tk/hr)			
ASC[45] Bus/Rickshaw van	N/S	N/S	N/S
Uncomfortable travelling condition	2.29	2.29	N/S
Market day	1.47	1.32	N/S
Fixed earner	14.72	14.76	N/S
Social and leisure travel	N/S	N/S	N/S
Travelling with load	0.48	0.52	N/S
Poor traveller	0.31	0.31	658.7
Travelling on poor road	N/S	N/S	8.26
Travelling on wet season	N/S	N/S	N/S
Other Statistics of the Models			
Rho_Sq	0.111	0.1064	0.0572
Rho_sq Const	0.0617	0.0575	0.0191
Scale Factor SP1	N/A	1.23	N/A
Scale Factor SP2	1.978	2.11	N/A
Scale Factor SP3	2.335	2.49	N/A
Scale Factor SP4	N/S	N/S	N/A
Scale Factor SP5	1.322	1.42	N/A
Scale Factor SP6	2.652	2.81	N/A
Scale Factor RP	N/A	N/A	N/A

Note: N/A – Not Applicable; N/S – Non-significant; USD 1 = Tk 57

** In-vehicle time of bus and rickshaw van was estimated jointly.
*** In-vehicle, walking and waiting times are estimated jointly.
[44] Simple average of male and female
[45] Alternative Specific Constant, to capture subtle preference towards certain mode.

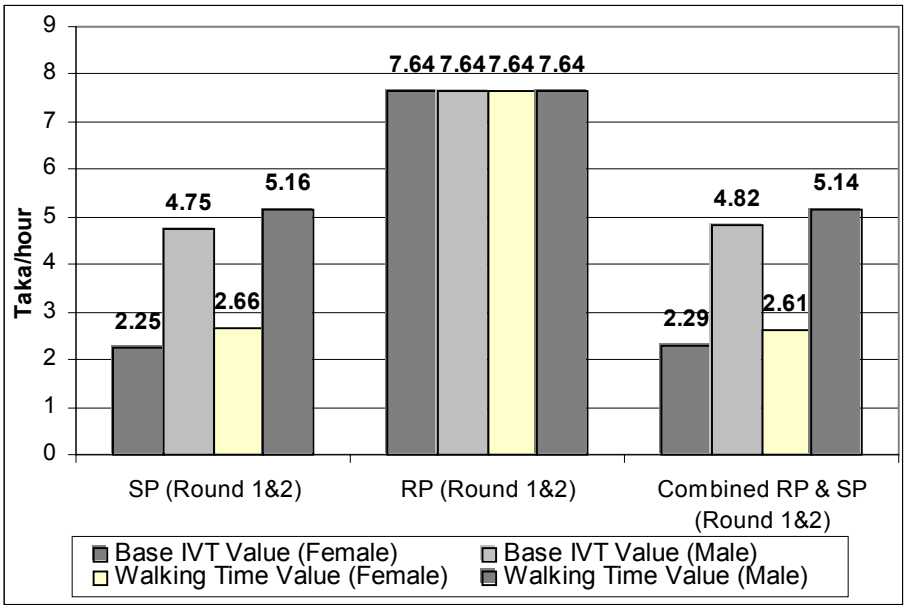


Figure 3: Comparison of base IVT and walking time values for different analyses

Figure 4, follows from Table 12, shows the combination of IVT values for various personal and travel attributes. For example, the value of non-working travel time savings for a man travelling on a market day with a load is estimated at Tk 6.70/hour (base value Tk 4.75/hour plus Tk 1.47/hour (additional value for travelling on the market day) plus Tk 0.48 /hour (additional value for travelling with the load) = Tk 6.70/hour).

The average base value of in-vehicle travel time savings is estimated at Tk 3.50 per hour (Table 12). Average walking time saving is valued at Tk 3.91, i.e. about 12% higher than the IVT. This higher value of walking time savings compared to IVT savings is expected as walking attracts higher disutility compared to in-vehicle travelling. However, the calculated walking time value is considerably lower in proportional terms compared to IVT when compared with the evidence from developed countries. For example, walking times are valued at 100% higher than the IVT values in the UK. However, the estimated walking time saving value in this case is, perhaps, explained by the fact that the rural population in developing countries are more accustomed to walking compared to their developed country counterparts, and also by the considerably more uncomfortable in-vehicle travelling conditions in rural Bangladesh. The value of average in-vehicle time savings is some 51% of the calculated rural wage rate of Tk 6.82/hour in Bangladesh (See Annex-XIV for calculation details). This is not considerably different from the ratio of perceived value to the gross salary/wage costs of 41% that has been calculated for the UK. Bristow and Nellthorp (2000) report that non-working time saving values vary between 10 to 42% of the working time values[46] in Europe. However, in our case the empirically derived values are the perceived values that need correction for taxes and subsidies to reflect the resource value using a Standard Conversion Factor (SCF).

[46] includes salary or wage rate plus an on-cost to represent the overheads such as national insurance, pensions etc.

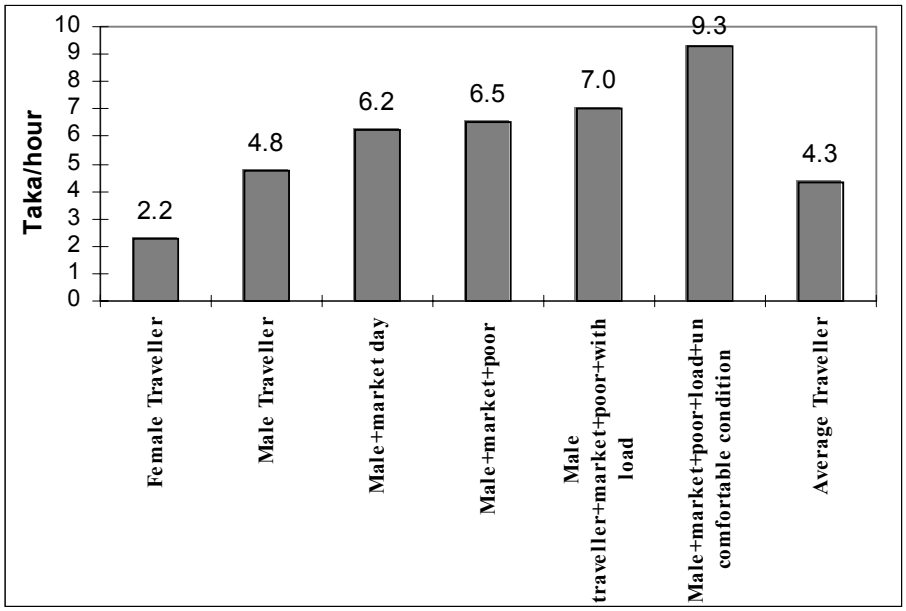


Figure 4: Base IVT saving values, combination of base IVT with other travel and personal attribute values and non-working time saving values of an average rural traveller

The average value of travel time savings on a market day was found to be 42% higher than non-market day travel. Male travellers attach 111% higher value for travel time savings compared to their female counterparts. The higher value for male travellers probably reflects a distortion due to an imbalance in the division of labour between genders and the control of the family finances by men. The disadvantage is probably felt most severely by women from poorer households who are under the most severe time constraints as indicated by the time budget analysis and the case of Taslima Begum in Box 2. The findings are consistent with the difference in wage rates between men and women which is considerable – Varma & Kumar (1996) reported that in 1991 the wage rate of an average woman was approximately two-thirds of an average man. Analysis of the activity data also shows that men spent significantly higher time in work (broadly in activities that directly related to earning or production such as trading, business and farming) than women. This is in conformity with the findings by Ahmed (1995b). However, it appears that women's value of time may have been underestimated in this study, especially in relation to essential non-economic activities and development and maintenance of social assets. Future studies could investigate this aspect in more detail with appropriate approaches to data collection from women.

Uncomfortable travelling conditions attract about 65% higher value than travelling under comfortable conditions. This is expected as travelling under uncomfortable conditions incurs higher disutility. The average in-vehicle time value for non-farm wage earners was found to be substantially higher (more than 400% higher) than that for other rural households (mainly farmers and farm workers). A possible reason for such a large difference is that on average non-farm wage earners were found to have a higher land area (per household and per capita) than others (Table 13). This is an indicator of wealth and also means that, perhaps, they shoulder job/business responsibilities along with the responsibilities related to agricultural production which imply a tight time-budget. Box 3 also confirms such a notion.

Table 13: Average land area per household for major non-farm wage earner and non-earner

	Average Land Area per Household (Acre)	Average Land Area per Capita (Acre)
Major Non-farm Wage Earner	2.80	0.49
Major Non-farm Non-Wage Earner	2.47	0.42

Surprisingly, no significant difference was found between values of travel time savings for essential (e.g. commuting, going to markets to sell produce etc.) and non-essential (e.g. travel for the purpose of social and leisure) travel. This may be due to a generalization of purpose of travel by the respondents when choosing options in the SP exercise, although they were asked to consider the options on the basis of the journey they were undertaking at the time of the interview. When the preliminary results of round 1 failed to significantly differentiate between time values for essential and non-essential travel, a special precaution was taken during round 2 data collection to alert the interviewees on this issue. The lesson is that rural people tend to generalise their travel purpose when stating their option during a SP exercise. The solution to get round this problem may be to specify in the questionnaires the type of travel they should be considering while choosing options in a SP exercise. However, it is often argued that the social and leisure trips in rural areas of a developing country should be judged in a different context than its developed country counterpart. Time spent on family gathering, community meetings, and religious activities is an important part of a rural society by which poor people seek to protect themselves from a variety of risks and to enhance the quality of their lives. Therefore, the social and leisure trips in rural areas of developing countries are often considered as an investment of time in social capital, with an expected but non-quantified return in terms of security and welfare. This is a significant area of divergence from the conventional valuation process which could usefully be studied further.

Travelling with a load increases the value of in-vehicle time roughly 14% over the average base value. Although, in general, passengers travelling with a normal amount of load (a small bag of agricultural produce or household goods like clothes, groceries etc.) are not charged an extra fare by bus or rickshaw van operators, they indeed attract additional disutility as they generally need to pay continuous attention to protect their goods from theft. Also in a crowded vehicle, they are forced by the operators to place their load on their lap to make extra space for fellow passengers (Box 2).

Box 2: Life struggles of two women: busy and poor or just very poor

TASLIMA BEGUM, in her late thirties, lives in Jhanpa village. Apart from her husband, she has two children below 16 years of age in her family. The family lives in a thatched house with two rooms, one used for sleeping and another for cooking and keeping cattle overnight. Taslima's husband is a daily paid casual agricultural labourer earning Tk 40 to Tk 70 per day depending on the season. The family does not own any cultivable land but she has rented about 0.25 acre of land beside the family home where she cultivates vegetables. She has leased (Barga) 1 cow and 1 goat from her neighbours with the condition that the calves and kids are shared 50:50 with the owners. She has two hens, which lay eggs off and on. Early in the morning, she drives her cattle and poultry from the shed to the yard and feeds them. Next, she does the household chores and cooks so that her husband has food to take with him to work. After her husband has left, she tends the vegetable garden and later takes the cow and goat to the field for grazing. She also collects fodder for the animals and fire-wood. After lunch, usually around 3:00 pm, she returns to the field to supervise the animals. She brings them home before sunset and puts the cow, goat and poultry in the shed before dark. Taslima starts cooking the evening meal when her husband returns from the market with provisions. She eats after feeding her husband and children. By this time, having worked the whole day, she is tired and so goes to bed, usually earlier than her husband. After dinner, her husband spends some time with the neighbours at the roadside shops, listening to the radio and talking.

The family earns a few Tk on and off from selling vegetables, milk and eggs. Usually her husband takes the produce to the hat (market) to sell. Taslima only asks for cash from her husband when she needs it, for example the bus fare for going to her parents' house or for buying glass bangles from the hawkers who come to their village. "My husband handles all the money in my family. He decides how to spend it, although he often asks for my suggestions, especially if they are related to buying clothes for me or the children or buying food during Eid. He definitely understands better than me when it comes to judicious spending of money," replied Taslima when asked why she did not keep part of the proceeds from the sale of milk, eggs and vegetables.

Taslima was interviewed when she was travelling to her mother's home by bus with about 10 kg of vegetables from her own garden. The bus fare was 8 Tk and the journey was slow, with a lot of waiting initially at the bus stand where she got on and at numerous stops on the way. It was also uncomfortable because she had to carry the vegetables on her lap to prevent theft. She could not start her journey before doing the early morning chores and had to return home by the evening to cook for the family and take care of the livestock.

JOHORA BIBI, a widow in her early 60s, of Birampur village in Jessore Sadar Upazila lives with her eldest son, a mason. There are eight persons in the family (herself, son, daughter-in-law and 5 grandchildren). Her son is the only earner in the family and brings home some Tk 100 a day. The family does not own any cultivable land and so they barely manage on the son's income. At the time of the interview, Johora Begum was returning from her brothers' house in Bagharpara Upazila to go to Jessore. She makes this journey twice a year. She had walked about 30 minutes to the main road as she could not afford the van fare, 6 to10 Tk depending on the time of the year for a 2 km journey. Her bus fare from Jessore was paid by her son and the fare for the return journey was paid by her brother. She does not earn any cash herself. Johora Begum has never in her life been to Dhaka or even Khulna (Divisional Headquarters).

Poor travellers attach marginally higher (9%) values to travel time savings compared to their non-poor counterpart. This higher figure for poor travellers may appear counterintuitive at first. However, if the following facts are considered, then it seems reasonable: average dependency ratio, a ratio of the number of non-income earners to the number of income earners in a household, is higher for poor than non-poor – 3.90 against 2.33 for poor and non-poor respectively; and the average number of income earners per poor household is also considerably lower than their non-poor counterpart – 1.0 against 2.24 per poor and non-poor respectively. This means that the average income earners in poor households have to make a greater effort to support non-earning family members compared to their non-poor counterparts within the fixed time budget in a day (Box 4). Discussions in Section 9.3 also support this argument; the average time spent on social and leisure activities by the adult poor is

significantly lower than the non-poor – both on normal as well as on busy days. This is true for both men and women.

Box 3: Higher willingness to pay by service holders and traders

KHALILUR RAHMAN operates a motorbike (locally known as motorcycle helicopter) on the Pulerhat-Rajganj Road on a commercial basis. These motorcycles are mainly cheap Chinese imports. There are quite a number of such commercially operated motorbikes on this road. A passenger is normally charged a fare of Tk 50 from Rajganj to Pulerhat or vice versa for a journey that normally takes 15-20 minutes compared to 40-45 minutes for a bus journey. The motorcycle fare is some five times higher than the bus fare of Tk 11. However, when two passengers are carried, a total of Tk 60 is charged, i.e. Tk 30 per head. The level of demand is high towards Jessore in the morning and toward Rajganj in the late afternoon when commuters go to and return from work . As reported by Mr Rahman, these type of services are mainly used by serviceholders and traders who prefer to go to work quickly as well as to avoid the discomfort of over crowded bus services in the morning rush hour.

Box 4: Life is a 365 day struggle for two poor travellers

RAHMAT ALI, aged around 25 comes from Baro Khudra village in Bandbila Union, Bagarpara Upazila. He lives in a one room tin-shed with his wife, a daughter and a son, aged 6 and 4 respectively. He has no land other than the homestead. Throughout the whole year, Rahmat Ali catches fish by traditional methods and sells them at different hats and markets - depending on the day of the week. He sets off very early in the morning – usually after morning prayer – for a beel (lake) or river near his home. He usually fishes until about midday or as late as 2 pm depending on the catch. He takes his catch, some 2 to 2.5 kgs - straight to the market and sells the fish, keeping some for his family, to beparis (small wholesale traders) or to individual customers – depending on the market he is selling at. His daily income varies from Tk 50 to 60. He rarely takes a day off from fishing, except when he needs to repair his home or for festivals.

Rahmat Ali buys the daily necessities for the family, including rice, every day from the money he gets from selling fish. His wife cooks after he arrives home with rice and other necessities. He usually returns home at around 6:00 to 6:30 pm on a hat day and 5 pm on a non-hat day. Cooking and eating dinner takes the family to around 8:00 pm. Usually Rahmat Ali goes to bed at 9:00 pm, except one day in a week when he watches television drama in one of his better-off neighbour's house. Rahmat Ali looked very irritated during the interview. "I may get some extra fish if I can reach the beel early" commented Rahmat Ali when asked why he looked so irritated.

ANWAR MULLAH, a butcher, just alighted from a bus from the Naricalbaria direction. He is a middle-aged person with a family of 7 persons, including his wife, mother and 4 children. The family owns some 1.5 Bigha (about half an acre) of land that includes his homestead land of some 1 Bigha. Because of his knowledge of cattle, he also trades in cattle at times of high demand, especially during Eid (a muslim festival at which animals are sacrificed). He sells meat from stalls at three markets in a week and earns about Tk 3,000 per month. His wife also rears cattle and poultry, and cultivates vegetables in the homestead garden. Selling of milk and vegetables brings another Tk 500 per month for the family. The family's small piece of land is cultivated by one of his relatives and the family receives a small quantity of paddy from the land.

Mr Anwar Mullah is busy seven days a week. On a non-hat day, when he does not sell meat, he goes to his mahajan's (large trader of cattle) place from where he buys cattle on credit. He also goes to his customers' homes to collect payment for meat sold on credit. The purpose of his journey at the time of the interview was to collect money from a customer. Anwar Mullah starts his day very early, usually straight after offering morning prayer. The time of going to bed is usually not before 9:30 pm but depends on his return from the market. He often spends some time with his friends in tea stalls at markets before returning home. "I am ready to pay more for a quicker journey, if the extra fare is not too high. I am always short of time, as you see. I wish I could spend more time with my family," commented Mr Mullah when asked if he was willing to pay more for a faster journey.

No significant difference was found between values of travel time savings on an improved road compared to a non-improved road. The expectation was that, as travelling on a non-improved road attracts higher disutility, the willingness to pay by travellers travelling on these roads should be higher than on their improved counterpart. No apparent explanation could be found for this result.

Travel time saving values for average rural traveller and conversion of working and non-working time values into resource values

Now the question is what figure should be used for appraisal of a rural road project. Should an average value of travel time savings be used in all rural road project appraisal, or different time saving values for different road types depending on usage by different social and gender classes be used? The average value approach is justified based on equity, but it is faulty when considered from an efficiency point of view. However, for practical[47] as well as equity[48] reasons, uniform or average time saving values are preferred rather than different values for different social and gender classes. In our case, allowing for the proportion of male and female travellers[49] on an average rural road and for the proportion of travellers with a load[50], the average non-working time saving value (perceived value) is calculated at Tk 4.30 per hour. This value is considerably lower than the quoted travel time saving financial value of Tk 12 per hour for feeder roads[51] (Ministry of Communications, 2001). However, the Ministry of Communications (2001) value is a weighted average of work and non-work time saving values. No other reference was found which quoted a separate value for non-working time saving in Bangladesh. However, in order to discriminate in favour of poor travellers, their time saving could be given a higher weighting in project appraisal. The value of working time savings should be equal to the wage rate, without any add-on costs. The marginal formal employment in rural areas of LDCs justify such argument. In our case TK 6.82 per hour should therefore be the financial value of working time saving.

However, the aforementioned working and non-working time saving values need adjustments to convert nominal values to resource values. Such adjustments are necessary in the case of working time savings in Bangladesh due to the existence of the unemployment and underemployment, and the taxes and subsidies. The adjustments are necessary in the case of non-working time savings for the taxes and subsidies correction. While in the case of working time savings values such adjustments are to be made using the shadow wage rate factor, in the case of non-working time savings values such adjustments are to be made with the SCF. The SCF and shadow wage rate factor are calculated at 0.88 and 0.75 for rural Bangladesh (see Annex-XV for details). It is also argued that in the case of for poor travellers there is no need

[47] As they require a large amount of personal and other attribute data of the travellers on the particular road to be appraised.
[48] In our case a road frequently used by the major non-farm earner will be easier to justify than a road frequented by poor agricultural and other labourers.
[49] Travel purpose survey, conducted as a part of the study, suggests the proportion of female on an average rural road is 0.18.
[50] Data from Swiss Agency for Development and Cooperation (SDC) assisted Noakhali Rural Infrastructure Development and Maintenance Project (NRIDMP) in Bangladesh suggests that some 6% of the travellers travel with a load on rural road.
[51] Feeder roads are at the upper end of the rural road network in Bangladesh.

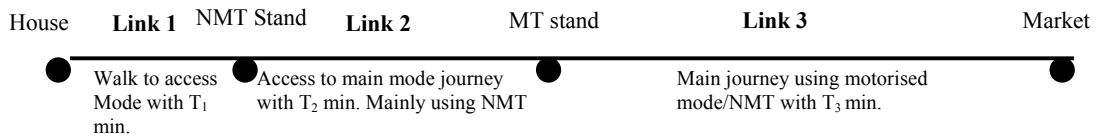
for adjustments of non-working time saving values with the SCF due to their marginal use of imported goods.

Therefore, the resource value of working and non-working time savings on an average rural road in Bangladesh are Tk 5.1 (Tk 6.82*0.75) per hour and TK 3.8 (Tk 4.3* 0.88) per hour respectively.

Suitability of preference approaches and indirect methods in valuation of travel time savings

One of the major findings of the study is the failure of the RP approach to provide a good model with reasonable in-vehicle and attribute time saving values. This was identified after the preliminary analysis of data from the first round. It looked at that time that the problem was due to improper coding and data entry of the complicated RP data. Therefore, before the start of the second round of data collection the RP questionnaire was reviewed and was simplified. Also coded data from the first round were checked and corrected. Some of the RP questionnaires were discarded after close scrutiny due to doubtful data. Responses from a total of 269 questionnaires in the first round could be used in the final analysis although data had been collected from 333 respondents. However, consistent results were still not obtained after combining the two rounds of RP data. The apparent problem was investigated further and the problems of using the RP method can be explained using the following figure that represents a journey by a rural resident from home to a market with agricultural produce. The entire journey comprised three main links:

- **Link 1** – distance walked from home to NMT stand and journey time of T_1 minutes;
- **Link 2** - distance travelled using access mode (generally NMT) if the link is suitable for NMT and journey time of T_2 minutes; and
- **Link 3** – distance travelled using main mode (motorised or NMT) if the link is suitable for both NMT and motorised transport and journey time of T_3 minutes.



The following scenarios explain the limitation of the RP approach in valuing time savings and other attribute values in rural areas. Examples are given of possible combinations of condition of different links:

(i) **Scenario 1: When conditions of all links are so bad that they cannot be served by any mode of transport** - This is not rare in rural Bangladesh for communities living away from all weather roads, especially in the wet season when the only option to rural residents is to walk to the market with their produce. Therefore,

because there is no trade-off, no information could be generated using the RP method. In such a case, the use of the RP method is not feasible at all;

(ii) **Scenario 2: When link 2 and link 3 are in such a state that they can only be used by the NMTs, e.g. rickshaw van, bicycle etc. -** This scenario is relevant for rural residents living in areas away from all weather roads, especially in the dry season. If a person is found to be using NMT the option that he rejected is walking. Therefore, the very limited practical range of choices restricts the use of RP method in the meaningful valuation of travel time savings; and

(iii) **Scenario 3: When link 1 cannot be served by any mode of transport, link 2 can be served by NMT only and link 3 can be served by any mode of transport** - This scenario can again be sub-divided into three:

1. when link 3 is short in length which is within the suitable operational range of an NMT (e.g. up to 10 km) and served by both NMT (like rickshaw van) and MT (like bus). This is most suitable for the use of the RP method as a feasible trade-off exists between NMTs and MTs. However, the trade-off between different MTs, such as express versus local bus service, is rare as express bus services usually do not operate in rural areas;

2. when link 3 is of moderate length (e.g.10 km to 20 km) which is within the possible operational range of the NMT but rarely served by the NMTs. In this case only a theoretical trade-off exists between NMTs and MTs. Therefore, establishing an NMT fare and time of travel compared to MTs is difficult as the respondents rarely use the former. In such a case, although use of the RP method is theoretically possible it is practically difficult. Again, trade-off between MTs is rare due to the reason given in above.

3. when link 3 is long (over 20 km) which is outside the operational range of NMTs. In this case the use of the RP method is not suitable due to the lack of possible trade-offs between NMTs and MTs and among MTs, given the reasons elaborated above.

Even if a realistic trade-off exists, it is difficult to establish in-vehicle time of the mode used by the respondents, let alone the competing mode. This is due to poor time keeping awareness of the rural people in Bangladesh, unlike their developed country counterpart. It is also applicable in case of walking time and waiting time for the mode used. Establishing the waiting time of the competing mode was found to be more difficult as it is rare that the commercial vehicles run following an established schedule. Usually commercial vehicles, like bus, tempo or rickshaw van, wait in their stand till adequate loads are obtained – i.e. “when full” type of operation. In such a case, the respondents report the waiting time of the competing mode on the basis of best guess. Another limitation of the RP method is its ineffectiveness in cases where new transport interventions are under consideration that necessitate the use of hypothetical scenarios for time valuation.

In this study the SP approach was tested for different transport infrastructure and service scenarios. It was effectively applied: (i) for motorized transport (SP1, SP2, SP3, SP4 and SP6) and for non-motorised transport (SP2, SP4 and SP5); (ii) for improved infrastructure (SP1, SP3 and SP5) and for non-improved infrastructure (SP2, SP5 and SP6); and (iii) for existing scenarios (SP1, SP3, Sp4 and SP5) and hypothetical scenarios (SP2 and SP6). The SP data analyses, both individual and joint analyses, have generated reasonable results of travel time valuation. The rural respondents from all social and gender classes were found to have responded rationally in choosing an appropriate option from the different alternatives, although they needed to be constantly advised by the interviewer about the cost implication of making their choice. However, it was found that rural respondents in Bangladesh tend to generalize their trip purpose in making the choice of option. Perhaps this is why no significant difference could be found in the value of travel time savings for essential and non-essential trips. The possible solution to this problem is to incorporate a specific journey purpose in the questionnaire to guide the respondents while making their choice of option.

The major problems in using the SP approach in the valuation of travel time savings are: its lengthy and slightly complicated procedure for experimental design; and the unusual modelling techniques which may become complicated if choice responses from different SP experiments need to be reconciled. It may require the assistance of experienced professionals to overcome these obstacles.

The possibility of using differences in labour wage rates, as an indirect method, for valuing travel time savings, was also investigated in general terms though not empirically tested. The general proposition is that differences in wages between local rural labour markets are at least partially explained by the "cost of access" to jobs outside the locality, which includes the monetary cost of travel and the cost in terms of time to travel to these jobs. It would in principle be possible to set out and test such a model in which the value of time is a function of wage rate differentials between localities and the time and monetary cost of travel.

Recent evidence from a study in Bangladesh on rural wage rate differentials is not encouraging (BIDS, 1998). The study found substantial variations in wage rates between villages. However, the variations were most pronounced between districts. Within districts, variations between Program and Control villages and between roadside and remote villages were relatively low and no systematic variations could be identified in these inter-village comparisons. In practice it is also difficult to separate the effect of time values from other features which influence the wage rate as this requires complex modelling techniques and large amounts of data that may eventually be intractable. Further, estimating the value of time based on wage differentials focuses only on the value of time of those in wage employment. Since the study evidence shows that travel to and from the work place is only 21% of the trips for "Wider socio-economic needs" and 16% of total trips (Table 10), an approach to valuing time based on wage rate differentials would only provide a partial picture – encompassing only trips made for the purpose of accessing work places i.e. commuting trips.

CONCLUSIONS AND RECOMMENDATIONS

11.0 CONCLUSIONS

The main purpose of the research was to develop, empirically test and disseminate a methodology for deriving travel time saving values in LDCs for transport/accessibility project appraisal. The research project was designed to produce four outputs: (i) Null-hypothesis I, "no value can be attached to travel time savings of rural residents in LDCs," is tested; (ii) Null-hypothesis II, "work and non-work journeys for rural residents in LDCs can be differentiated," is tested; (iii) Travel time saving values for rural residents in an area of a developing country for different journey types, modes, seasons and social classes are obtained if the empirical evidence led to the rejection of Null Hypothesis I in the specific case of a locality of a developing country; and (iv) A useful contribution to the debate on the validity of including values of travel time savings when appraising rural transport/ accessibility projects in LDCs is made.

In order to achieve its purpose and to produce the outputs, household and roadside surveys were conducted in Jessore district in south-western Bangladesh with 9 types of questionnaires – one to collect household socio-economic data, one related to the RP method, six related to the SP method, and one to collect data on travel purpose. Data were collected from a total of seven roads. The study has a socio-economic component to examine the implications of the socio-economic characteristics of the rural populations in LDCs for the applicability of conventional models for valuing time.

The detailed research methodology is presented in section 8.0. Section 9.0 and 10.0 presented and discussed the results of the socio-economic and travel purpose data analysis and preference data analysis respectively. Section 10.0 also discussed other relevant issues of valuation of travel time savings in rural areas in LDCs such as suitability of indirect approach in valuing travel time savings, suitability of RP and SP approaches in rural travel time savings valuation in LDCs. This section presents the conclusions of the study based on the discussions in earlier sections.

The conclusions of the study are arranged into three distinct parts: overall conclusions; conclusions in relation to project outputs and purpose, and conclusions in relation to the implications of the study findings on appraisal methodology and policy.

11.1 Overall conclusions

<u>Conclusions on socio-economic characteristics, time budget and travel purpose</u>

- Econometric techniques were found to be suitable in identifying indicators and in estimating their coefficient values for their subsequent use in preference questionnaires to differentiate the responding travellers into social groups based on per capita household consumption expenditure;
- The time of sleep for an average poor person is significantly higher than their non-poor counterpart. This is also true for an average poor man. However, the time of

sleep for an average poor woman is found not to be significantly different from that of her non-poor counterpart;

- An average non-poor person spends a significantly higher time for social and leisure activities compared to an average poor person. This is true for an average non-poor man and an average non-poor woman;
- In other cases (like time for work, domestic work and sleep, social and leisure combined) no significant differences were found between an average poor and an average non-poor. This is true for both an average man and an average woman;
- Some three in four trips are made to meet household's wider socio-economic needs and one in four for social and leisure purposes;
- There is a difference in the split between the trip purpose categories for men and women, with a larger proportion of the women's travel being for "social and leisure" purposes that includes meeting social obligations;
- Approximately one in four trips made for "wider socio-economic needs" is for the purpose of "For purchase/selling of goods for profit" followed by one in five trips for the purpose of "For going and coming from work place";
- Less than 1% of the trips made by rural travellers can be categorised as working trips if the conventional definition is followed. The proportion rises to about 3.5% of the overall trips if the trips made by the self-employed during work is considered together with the trips made for working under an employer. Trips made for the purpose of buying/selling of goods for profit constitute a substantial proportion of the trips – roughly 18% of the overall trips. When this category of travel is included under the working trips category, then working trips constitute some 21% of all trips (nearly 30% of the trips made for the purpose of wider socio-economic needs);
- Considering the nature of rural economy in Bangladesh, it appears justifiable to redefine working trips. The newly defined working trips include: trips made in the course of work for an employer, trips made in the course of work as self employed, and trips made for purchase/selling of goods for profit. Time saving values of theses trips should be equal to at least the wage rate;
- Only 14% of the trips were found to have more than one purpose. This is less than expected. This finding seems justified if rural residents' trip patterns are considered. The rural residents in Bangladesh make more frequent but shorter trips compared to their African counterpart. However, this finding may be considered unique to Bangladesh or a country with high a population density and facilities and services that rural people need accessing are closer.

Conclusions on Values of Travel Time Savings

- The average base value (simple average values of men and women) of in-vehicle travel time saving was estimated at Tk 3.50/hour – approximately 51% of the estimated wage rate in the study area;
- Average walking time savings value was about 11% higher than the IVT;

- Average value of travel time savings on a market day was 42% higher that the non-market day travel;
- Men travellers attached 111% higher value for travel time savings compared to women;
- The average in-vehicle time value of major non-farm earners was found to be substantially higher than the non-earner – more than 400% higher;
- No significant difference was found between values of travel time savings for essential and non-essential travel;
- The average value of in-vehicle time while travelling with a load was found to be some 14% higher than without a load;
- Poor travellers attached marginally higher (9%) values to travel time savings compared to their non-poor counterparts;
- No significant difference was found between values of travel time savings while travelling on an improved road compared to a non-improved road; and
- Travelling under uncomfortable conditions attracted about 65% higher value than travelling under comfortable conditions.

<u>Conclusions on suitability of RP, SP and alternative approach</u>

- Although from theoretical point of view the RP approach is considered to be the best approach for evaluation of travel time saving values, empirical evidence suggests problems with the method when applied to a rural situation in a developing country. The RP approach was found to have the following limitations in the valuation of travel time savings:
    (i) It is only applicable when realistic trade-offs exist between different modes or within-mode, which may be marginal in rural areas of LDCs;
    (ii) It is difficult to capture RP data due to the complicated trips characteristics of rural travellers that may involve use of several modes including walking;
    (iii) Bangladesh experience shows that it is difficult to establish in-vehicle time of the used mode, let alone the competing mode, and walking time due to poor time keeping awareness of rural travellers;
    (iv) It is even more difficult to establish the waiting time of the competing mode, as the commercial vehicles operate on "when full" basis; and
    (v) RP data collection is lengthy and expensive.
- Empirical evidence from Bangladesh shows that SP is the most suitable approach for valuing rural non-working travel time savings. However, the main obstacles to using the SP approach are its lengthy and slightly complicated procedure of experimental design and the unusual modelling techniques that may get complicated if choice responses from different SP experiments need to be reconciled;

- Although not empirically tested, theoretical review shows that the use of wage rate differences as an alternative method of valuing travel time savings is unlikely to be feasible. This is due to: (i) non-systematic and low inter-village variations of the wage rate; (ii) difficulty of separation of the effect of time values from other features that influence the wage rate as they require complex modelling techniques and large amounts of data; (iii) an approach to valuing time based on wage rate differentials would only provide a partial picture encompassing trips made for the purpose of accessing work places i.e. commuting trips.

Conclusions on travel time savings for average rural traveller and conversion of working and non-working time values into resource values

- The working time saving value (financial) should at least be equal to the average wage rate in the study area – calculated at Tk 6.82 per hour. The resource (economic) value, after adjustment with a shadow wage rate factor, was calculated at Tk 5.1 per hour;
- The weighted average non-working travel time saving value (perceived or financial) for the study area in rural Bangladesh was estimated at Tk 4.3 per hour – i.e. about 63% of the estimated wage rate in rural Bangladesh. The resource (economic) value, after making adjustment for taxes and subsidies with the SCF, was calculated at Tk 3.8 per hour.

11.2 Conclusion in relation to outputs and purpose

Conclusion on outputs

Output 1: Null-hypothesis I, "no value can be attached to travel time savings of rural residents in LDCs," is tested;

- The null hypothesis can be rejected as the results of the field study showed that rural residents can, indeed, attach a value to travel time savings – these values were found to be are statistically significant and were estimated using modelling process following standard statistical procedures.
- **Output 2**: Null-hypothesis II, "work and non-work journeys for rural residents in LDCs can be differentiated," is tested;
- The null hypothesis cannot be rejected as the field study results showed that work and non-work journeys can be differentiated. However, if the conventional definition is followed, only a marginal proportion of trips can be categorized as work trips. Considering the nature of rural economy in LDCs, there is a need for redefining the work trips.

- **Output 3**: Travel time saving values for rural residents in an area of a developing country for different journey types, modes, seasons and social classes are obtained if the empirical evidence led to the rejection of Null Hypothesis I;

- As a consequence of rejection of Null-hypothesis I, the following are the estimated non-working travel time saving values:
- **Base Value (Tk/hour):**

  - In-vehicle time (male): 4.75
  - In-vehicle time (female): 2.25
  - In-vehicle time (average): 3.50
  - Walking time (male): 5.16
  - Walking time (female): 2.66
  - Walking time (average): 3.91

Additional Value (Tk/hour)

:

  - Uncomfortable travelling condition: 2.29
  - Market day: 1.47
  - Fixed earner: 14.72
  - Social & leisure travel: Not significant
  - Travelling with load: 0.48
  - Poor traveller: 0.31
  - Travelling on poor road: Not significant
  - Travelling in wet season: Not significant

.

Output 4: A useful contribution to the debate on the validity of including values of travel time savings when appraising rural transport/ accessibility projects in LDCs is made.

- This output can be considered to have been achieved. The study findings were presented in a final workshop, attended by professionals, academics, representatives from relevant DFID divisions and a representative from a multilateral lending organisation. Written comments from the participants helped in the finalisation of the study report. A large number of requests expressed through informal contacts show the interest generated by the study. The study findings will be disseminated using DFID's transport links website (www.transport-links.org). Also the findings will be published in relevant national and international journals and conference proceedings.

Conclusion on research purpose

The purpose of the research was *to develop, empirically test, and disseminate a methodology for deriving VOT in LDCs for transport/accessibility project appraisal*.

- Empirical results of field testing of the methodology for valuing travel time savings in rural Bangladesh indicate that the western concept of dividing travel time savings into working and non-working categories is valid in rural context of a LDC. However,

considering the nature of rural economy in LDCs, there is a need for redefining the work trips;

- Among the preference approaches for valuation of non-working travel time savings, SP was found to be the most suitable approach as its suitability was successfully tested for different infrastructure and travel alternatives;
- There is a need to adjust the working time saving values, when equated to the wage rate, with a shadow wage rate factor and the non-working time saving values with the SCF. In the case of working time saving values such adjustments are necessary to represent the resource value of productivity of labour in an alternative use. The wage rate may not always represent the resource value due to the market distortions caused by unemployment, underemployment, taxes and subsidies. The non-working time saving values also need an adjustment to adjust for taxes and subsidies.

11.3 Implications for appraisal methodology and policy

- Empirical results from rural Bangladesh show that there is a case to support the inclusion of benefits during rural transport or access project appraisal in the LDCs from travel time savings which are due to transport infrastructure and/or service improvements;

- Bangladesh study suggests that the western concept of dividing travel time savings into working and non-working time savings is valid in developing country context. However, working trips will need redefining depending on the nature of the rural economy of a developing country. The proportion of trips under working trips category may only be marginal following conventional definition of these trips as the results of the study suggest. The redefined working trips should include trips those have opportunity costs of lost time equal to the marginal value of income of the travellers In Bangladesh case they include: trips made in the course of work for an employer, trips made in the course of work as self employed, and trips made for purchase/selling of goods for profit.

- Although a unique value of non-working time saving is justified from an equity point of view, there can be cases where differentiation is reasonable. In particular, in cases where the value of time of poor travellers is higher than their non-poor counterpart, as in the case of rural Bangladesh, their time savings could be given a higher weighting in order to discriminate in favour of the poor travellers;
- The study findings may also be extended in the appraisal of other sectors. Notable among them are water and health sectors. However, further empirical studies would be required to test the applicability of the approach in different circumstances.

11.4 Recommendations

Bangladesh exhibits a number of specific characteristics which make generalisation from this study problematic; it has a very dense population (about 900 per sq km), high proportion of landless seeking work (roughly 40% of the rural households are landless) and a well developed non-motorised transport sector. This study needs to be extended to other developing countries, particularly those exhibiting very different transport, population and cultural context from Bangladesh.

The study findings are not relevant to the transport sector only. Its findings may also be extended in the appraisal of other sectors. Notable among them are water and health sectors. However, further empirical studies would be required to test the applicability of the approach in different circumstances.

Following further empirical studies, this approach to valuing travel time savings in developing countries needs to be disseminated through user friendly technical guidelines ('How to' manuals) as well as policy guidelines.

BIBLIOGRAPHY & REFERENCES

Ahmed, F, 1995a, "*Rural Transport Planning in Bangladesh : Towards a Comprehensive and Integrated Approach"* Unpublished Masters Thesis, University of South Australia

Ahmed, F, 1995b, "Rural Transport in Bangladesh: Impact of Non-Motorized Transport on Households' Activity Travel Patterns." *Journal of the First Conference of the Eastern Asian Society for Transportation Studies (EASTS)*

Ahmed, F, 1997, "Rural Transport Planning in Bangladesh: Gender and Social Class Bias." *Journal of the Second Conference of the East Asia Society for Transportation Studies (EASTS),* Vol 2 No.5

Asthana A N, 1995, 'Demand analysis of RWS in Central India', *paper presented at 21st WEDC Conference: Sustainability of water and sanitation systems, Kampala, Uganda*

B'Arcier B F Andan O and Raux C, 1998, 'Stated Adaptation Surveys and Choice Process : Some Methodological Issues', *Transportation*, 25, pp 169-85

Bangladesh Bank, 2001, Economic Trends, Vol.XXVI No.11, Bangladesh Bank, Dhaka

Bangladesh Bureau of Statistics, 1996, *Bangladesh Population Census 1991, Zila: Jessore***,** Bangladesh Bureau of Statistics, Dhaka

Bangladesh Bureau of Statistics, 1999a, *Census of Agriculture-1996, BBS, Vol.I, July 1999, Zila: Jessore***,** Bangladesh Bureau of Statistics, Dhaka

Bangladesh Bureau of Statistics, 1999b, *Statistical Pocketbook*, Bangladesh Bureau of Statistics, Dhaka

Bangladesh Bureau of Statistics, 2000, *1999 Year Book of Bangladesh*, Bangladesh Bureau of Statistics, Dhaka

Bangladesh Bureau of Statistics, 2001a, *Monthly Statistical Bulletin Bangladesh: June 2001*, Bangladesh Bureau of Statistics, Dhaka

Bangladesh Bureau of Statistics, 2001b, *Population Census 2001: Preliminary Report*, Bangladesh Bureau of Statistics, Dhaka

Bangladesh Institute of Development Studies (BIDS) (1998) *Socio-economic impact of Rural Roads and Markets Improvement and Maintenance Project II (RRMIMP-II)",* Phase I Report, Dhaka, December.

Bangladesh Institute of Development Studies (BIDS), 1998, *Socio-economic impact of Rural Roads and Markets Improvement and Maintenance Project II (RRMIMP-II): Phase I Report*, BIDS, Dhaka

Bangladesh Institute of Development Studies (BIDS), 2000, *Fighting Human Poverty: Bangladesh Human Development Report 2000*, BIDS, Dhaka

Barwell I, 1992, Synthesis of Finding and Conclusion from Village-Level Travel and Transport Surveys and Related Case Studies. I T Transport/International Labour Organisation, Oxon/Geneva.

Becker G S, 1965, 'A Theory of the Allocation of Time', *Economic Journal*, Sep, 1965

Beesley M E, 1965, 'The Value of Time Spent Travelling; some new evidence', *Economica*, May, 1965

Booz-Allen & Hamilton Ltd., 2000, *PEM Benefit Parameter Project : Development of Research Approaches (Draft),* Booz-Allen & Hamilton, n.p.

Braden and Kolstad (eds) (1991) *Measuring the demand for environmental quality* Amsterdam: North-Holland.

Bristow A L & Nellthorp, 2000, 'Transport Project Appraisal in the European Union, *Transport Policy*, 7(1), pp. 51-60.

Broom D, Lowe S R, Gunn H F and Jones P M, 1983, 'Estimating Values of Time: An experimental Comparison of Transfer Price Methods with the revealed Preference Approach', *Proceedings of Seminar N, PTRC Summer Annual Meeting*, Brighton

Bruzeliun N, 1979, *The Value of Travel Time*, Croom Helm, London

Carvalho S and White H, 1997, "Combining the quantitative and qualitative approaches to poverty measurement and analysis: The practice and the potential", *World Bank Technical Paper No. 366*, World Bank, Washington

Chiswick, B R, 1967, 'The Economic Value of Time and the Wage Rate: comment', *Western Economic Journal*, Mar, 1967

Dawson, J. and Barwell, I. (1993) Roads are not Enough: New Perspectives on Rural Transport Planning in Developing Countries. Intermediate Technology Publication, London.

De Serpa R C, 1971, A Theory of the Economics of Time, *Economic Journal*, Dec, 1971

Department of Transport (UK), 1987, *Values for Journey Time Savings and Accident Prevention*, Department of Transport, London

Department of Transport, 1995, *Draft COBA 9 Manual*, Highways Economics and Traffic Appraisal Division, London

Ellis F, 1998, "Survey article: Household strategies and rural livelihood diversification" *The Journal of Development Studies*, Vol.35, No.1, pp.1–38.

Ellis S D, 1997, 'Key Issues in Rural Transport in Developing Countries', *TRL Report 260*, Transport Research Laboratory, Crowthorne

Evans A W, 1972, 'On the Theory of the Valuation and Allocation of Time', *Scottish JPE*, Feb, 1972

Foster, C D, Beesley, M E, 1963, 'Estimating the Social Benefit of Constructing an Underground Railway', *JRSS*, vol 126, 1963

Fowkes A S, 1986, 'The UK Department of Transport Value of Time Project', *International Journal of Transport Economics*, Vol. XIII, No.2, pp197-207.

Fowkes A S, 1992, 'How Reliable is Stated Preference?' *ITS Working Paper 377*, Institute for Transport Studies, University of Leeds, Leeds

Fowkes T & Wardman, M (1988) 'The Design of Stated Preference Travel Choice Experiments-With Special Reference to Interpersonal Taste Variation', *Journal of Transport Economics and Policy*, Vol. XXII, No. 1, pp27-44

Gertler, P and van der Gaag, J, 1990, *The Willingness to Pay for Medical Care.* Baltimore: The Johns Hopkins University Press.

Gwilliam K M, 1997, *The Value of Time in Economic Evaluation of Transport Project (Infrastructure Notes No. OT-5),* The World Bank, Washington DC

Hague Consulting Group (HCG) and Accent (19956), *The Value of Time on UK Roads – 1994 Prepared for Department of Transport*

Haney D C, 1967, *The Value of Time for Passenger Cars: A Theoretical Analysis and Description of Preliminary Experiments*, Stanford Research Inst., 1967

Haning C R, Mc Farland W F, 1963, 'The Value of Time Saved to Commercial Vehicles Through the Use of Improved Highways', *Texas Transportation Inst., Bul 23*, 1963

Harrison A J & Quarmby D A, 1970, 'The Value of Time in Transport Planning', *Conference E Ministers of Tspt*, 1970

Harrison A J, & Quarmby D A, 1969, Theoretical and practical research on an estimation of time-saving , ECMT Sixth Round Table: OECD Paris and Washington, 1969

Harrison A J, 1974, *Economics of Transport Appraisal*, Croom Helm, 1974

Hayashi Y & Morisugi H, 2000, 'International Comparison of Background Concept and Methodology of Transportation Project Appraisal', *Transport Policy*, 7(1), pp. 73-88.

Heggie I G, 1976, *Modal Choice and the Value of Travel Time*, Oxford, 1976

Heideman C et al, 1985, 'Rural Transport in Developing Countries', *IFR Research Report*, GTZ, 1985

Hensher D A and Truong, T P (1983) 'Values of Travel Time Savings from a Revealed Preference Approach and A Direct Experimental Approach', *Research Paper 269*, School of Economics and Financial Studies, Macquaire University, Australia

Hensher D A, 1994, 'Stated Preference Analysis of Travel Choices : The State of practice' *Transportation*, Vol. 21, no.2 pp. 107-33

Hensher D A, 1977, *The Value of Business Travel Time*, Pergaman, Oxford, 1977

Hensher D, 1973, *Review of Studies Leading to Existing Values of Travel Time*, Highway Research Board, Washington, 1973

Hine J, Pangihutan H & Rudjito D, 1998, *A Study of the Value of Time in Indonesia Using Stated Preference Data*, Road Research Development Project, IRE, Bandung

Howe JDFG, 1971, 'The Value of Time Savings from Road Improvement : a Study in Kenya', *TRRL Laboratory Report No 372*, Transport and Road Research Laboratory, Crowthorne

Howe JDFG, 1976, 'Valuing time savings in developing countries', *Journal of Transport Economics and Policy*, Vol. 10, No.2, pp. 1-13

I T Transport, 2001, *The Value of Time in Least Developed Countries: Review of Present Position and Future Direction of Research*, I T Transport, Ardington

Kocur G, Adler T, Hyman W & Audet B, 1982, *Guide to Forecasting Travel Demand with Direct Utility Assessment*, US Department of Transportation, UMTA, Washington DC.

Lee D B Jr, 2000, 'Method for Evaluation of Transportation Projects in the USA, *Transport Policy*, 7(1), pp. 41-50.

Lee N & Dalvi M W, 1971, 'Variations in the Value of Travel Time: Further Analysis', *MSESS*, Sep, 1971

Lee N & Dalvi, M W 1969, 'Variations in the Value of Travel Time', *MSESS*, Sep, 1969

Leitham S, McQuaid R W & Nelson J D, 2000, 'The Influence of Transport on Industrial Location Choice : A Stated Preference Experiment', *Transportation Research Part A*, 34, pp. 515-535

Lema C I, 2000, *Rural Transport Infrastructure Improvement in Tanzania: Communities Ability and Willingness to Pay, MA Dissertation (Unpublished),* Institute for Transport Studies, The University of Leeds, Leeds

Leslie J (1991) 'Women's Nutrition: the Key to Improving Family Health in Developing Countries?' *Health Policy and Planning* 6(1):1-19.

Little I M D & Mirlees J A, 1974, *Project Appraisal and Planning for Developing Countries, Heinemann*, London

Litvack, J and Bodart, C, 1992, 'User Fees Plus Quality Equals Improved Access to Health Care--Particularly for the Poor: Results of a Field Experiment in Cameroon' *Social Science and Medicine.*

M Ward, 1976, *Milne Bay Access Study*, University of New South Wales, Sydney

Mahmud W, 1996, 'Empolyment Patterns and Income Formation in Rural Bangladesh: The Role of Rural Non-farm Employment' *The Bangladesh Development Studies*, Vol. XXIV, no.3 & 4, pp. 1-27

Mansfield N W, 1969, 'Recreational Trip Generation', JTEP, May, 1969

Marks P and Wardman M, 1991, 'Leisure Travel' in *Fowkes T and Nash C edited Analysis Demand for Rail Travel*, Avebury

Ministry of Communications, 2001, *RHD Road User Cost Annual Report for 2000-2001*, Government of the People's Republic of Bangladesh, Dhaka

Morisugi H, 2000, 'Evaluation Methodologies of Transportation Projects in Japan', *Transport Policy*, 7(1), pp. 35-40.

MVA Consultancy, ITS of the University of Leeds and TSU of the University of Oxford, 1987, *The value of Travel Time Savings : A Report of Research Undertaken for the Department of Transport*, MVA Consultancy

MVA Consultancy/Institute for Transport Studies, University of Leeds/Transport Studies Unit, University of Oxford, 1987, 'The Value of Travel Time Savings', *Policy Journal*, Newbury

Nelson J P (1982) "Airport and property values: a survey of recent evidence", *Journal of Transport Economics and Policy* 14: 37-52.

Ortuzar J de D, Garrido R A, 1994, 'A Practical Assessment of Stated Preference Methods', *Transprotation*, 21, pp 289-305

Ortuzar J de D, Willumsen, 1996, *Modelling Transport (Second Edition)*, Willey, Chichester
Overseas Development Administration, 1988, *Appraisal of Projects in Developing Countries: A Guide to Economist*, Her Majesty's Stationary Office, London

Pearmain D and Kroes E, 1990, *Stated Preference Techniques : A Guide to Practice*, Steer Davies and Gleave Ltd., Richmond

Pendleton L and Mendelsohn R (2000) "Estimating recreation preferences using hedonic travel cost and random utility models", *Environmental & Resource Economics,* 17 (1): 89-108.

Quinet E, 2000, 'Evaluation Methodologies of Transportation Projects in France', *Transport Policy*, 7(1), pp. 27-34.

Rashid H E, 1977, *Geography of Bangladesh*, Westwide Press, Boulder.

Rothengatter W, 2000, 'Evaluation of Infrastructure Investments in Germany', *Transport Policy*, 7(1), pp. 17-25.

Shahabuddin Q and Rahman K M, 1992, *Estimation of Economic Prices for Use in FAP Planning Studies*

Smith V K and Karou Y (1990) "Signals or noise ? Explaining the variation in recreation benefit estimates", *American Journal of Agricultural Economics,* 419-433.

Squire L & van der Tak H G, 1975, *Economic Analysis of Projects*, Johns Hopkins University Press, London

Talvitie A, 2000, 'Evaluation of Road Projects and Programs in Developing Countries', *Transport Policy*, 7(1), pp. 61-72.

Thomas S, 1983, 'The Value of Time Savings in West Malaysia: Car, Bus and Taxi Occupants', *TRRL Supplementary Report No 777*, Transport and Road Research Laboratory, Crowthrorne

Tipping D G, 1967, Time savings in Transport Studies, EJ, Dec, 1968

UNCTAD, 2001, *Statistical Profiles of the Least Developed Countries,* UNCTAD, New York

Varma S & Kumar P, 1996, 'Rural Non-farm Employment in Bangladesh' *The Bangladesh Development Studies*, Vol. XXIV, no.3 & 4, pp. 75-101

Varma S, 1996, 'Rural Non-Farm Employment in Bangladesh' *The Bangladesh Development Studies*, XXIV (3 & 4), pp. 75-101.

Vickerman R, 2000, 'Evaluation of Methodologies for Transport Projects in the United Kingdom', *Transport Policy*, 7(1), pp. 7-16.

Viloria, J G, 1992, *The Sri Lanka Community Water and Sanitation Project (CWSP),* Cr. 2442-CE, Effective VY92, Asia Technical Department Human Resources and Social Development Division, World Bank.

Wardman M, 1988, 'A Comparison of Revealed Preference and Stated Preference Models of Travel Behaviour', *Journal of Transport Economics and Policy*, XXII (1), pp 71-91

Wardman M, 1997, *A Review of Evidence on the Value of Travel Time in Great Britain (Working Paper 495)*, Institute for Transport Studies, The University of Leeds, Leeds

Wardman, M & Whelan G, 1998 *Rolling Stock Quality Improvements and User Willingness to Pay, Working Paper 523*, Institute for Transport Studies, University of Leeds

Whittington, D; Xinming Mu; Roche, R, 1990, 'Calculating the Value of Time Spent Collecting Water: Some Estimates for Ukunda, Kenya', *World Development*. Vol. 18 (2). p 269-80. February 1990.

World Bank, 1996, *Bangladesh Rural Infrastructure Strategy Study*, The University Press Limited , Dhaka

World Bank, 2001a, *World development indicators database*, Web site

World Bank, 2001b, *World Development Report: Attacking Poverty*, World Bank, Washington DC.

Yucel N C, 1975, *A Survey of the Theories and Empirical Investigations of the Value of Travel Time Savings Bank Staff Working Paper No. 199*, World Bank, Washington DC

Annex-I

Derivation of Marginal Valuation of Time Spend on an Activity, including Travel

This Annex of derivation of marginal valuation of time spent on an activity, including travel, is principally based on the MVA/ITS/TSU (1987) analysis. However, an attempt has been made to explain it in comparatively simple terms.

The classical economic theory of consumer behaviour is based on the assumption of a rational person deriving utility from the consumption of commodities and attempts to maximise this utility subject to available resources. For example, if an individual earns an income of Y and consumes a vector of commodities x, whose prices are represented by the vector p, then the mathematical expression of this problem will be:

$$\text{Max } U(x) \text{ subject to } p.x \leq Y \ldots\ldots\ldots (2.1.1)$$

The consequent Lagrangean expression for constrained maximisation will be:

$$L = U(x) + \lambda (Y - p.x) \ldots\ldots (2.1.2)$$

Differentiating with respect to x and setting to 0 for the first-order conditions will give:

$$\delta U / \delta x_i = \lambda . p_i \ldots\ldots\ldots (2.1.3)$$

In the aforementioned expressions λ is the Lagrangean multiplier. In case of constrained maximisation with inequality constraints, as here, if the constraint does not bind, then the associated Lagrangean multiplier has a zero value, i.e. in this case $\lambda = 0$. In the above case, if the individual does not use all the income available to him/her, i.e. if he/she would not like to consume more than what he/she earns, then the budget constraint is not bound and value of the constraint does not bind, then $\lambda = 0$. This effectively means that the marginal utility of an additional unit of income for him/her is zero. In the normal case, when the individual would like to consume more than he/she can afford, λ is the marginal utility of an additional unit of income.

This theory and its related interpretations can be extended to find a theoretical interpretation of the value of time while travelling. However, to do so, some simplifying assumptions are necessary. This is because the complete theory of time allocation embraces all aspects of human behaviour and taking all of them into consideration is unmanageable.

Let us consider that an individual's utility is composed of a vector of commodities x, and a vector of time spent in different activities, t. For convenience, let us also assume that one of the activities is work and time spent in work is t_w. His/her income may consist of two sources: work and non-work sources (e.g. remittances from relatives). His/her total income may be expressed as $w.t_w+y$; where, w is the wage rate and y is the income from non-work source, both net of tax. Let us also assume that he/she has to work a minimum number of hours (t_w^*) and requires minimum time for other time vectors (t_i^*).

Given the aforementioned restriction, the formulation of previous constrained maximization model will take the following form:

$$\text{Max}U(x_1, x_2, ...x_n, t_1, t_2, ...t_n, t_w) \ldots\ldots\ldots (2.2.1)$$

subject to the following constraints:

$$w.t_w + y \geq p.x \ldots\ldots \quad (2.2.2)$$

$$T \geq \sum t_i + t_w \ldots\ldots\ldots \quad (2.2.3)$$

$$t_w \geq t_w^* \ldots\ldots\ldots \quad (2.2.4)$$

$$t_i \geq t_i^* \ldots\ldots\ldots \quad (2.2.5)$$

The subsequent Lagrangean expression will take the following form:

$$L = U(x, t, t_w) + \lambda(wt_w + y - px) + \mu(T - \sum t_i - t_w) + \phi(t_w - t_w^*) + \sum_i \psi_i.(t_i - t_i^*) \ldots (2.2.6)$$

Differentiation with respect to w, t and t_w will give the following expression:

$$\delta U / \delta x_i - \lambda\, p_i = 0 \ldots\ldots (2.2.7)$$

$$\delta U / \delta t_w + \lambda w - \mu + \varphi = 0 \ldots\ldots (2.2.8)$$

$$\delta U / \delta t_j - \mu + \psi_j = 0 \ldots\ldots (2.2.9)$$

Now from eqs.2.2.8 and 2.2.9 we get the following equation:

$$(\delta U / \delta t_j)/\lambda = w + (\delta U / \delta t_w)/\lambda + (\varphi/\lambda) - (\psi_j/\lambda) \ldots\ldots (2.1)$$

Where:
$(\delta U/\delta t_j)$ is the marginal utility of time in activity j;
λ is the marginal utility of income;
$(\delta U/\delta t_j)/\lambda$ is the marginal valuation of time spent in activity j
(Φ/λ) is the marginal valuation of time for decreasing the minimum working time required;
(ψ_j/λ) is the marginal valuation of decreasing the minimum other time required

The marginal valuation of time in activity j may also be viewed in the following way (from Eq. 2.2.9):

$$(\delta U / \delta t_j)/\lambda = \mu/\lambda - \psi_j/\lambda \ldots\ldots (2.2)$$

When ψ_j is zero, i.e. when the time constraint does not bind, the marginal valuation of time in activity j is equal to μ/λ, also known as the 'resource value of time'. It represents a consumer's willingness to pay to have the total time budget increased, although in reality a complete relaxation of the time budget constraint is not feasible. This is interpreted as the marginal valuation of the 'pure leisure' time at the optimum.

Annex-II

Some Basic Facts of Bangladesh

All $ figures are in US$

		Note
Basic Socio-Economic Geographic Profile		
Population (2001 census)	129.2 million	
% of population living in urban areas	24%	
Population below age 15	39%	
Male-female ratio	103.8:100	
% of population having access to improved water sources	97%	
% of population having access to essential drugs	65%	
Annual Population growth	1.9%	
Infant Mortality Rate (per 1000 live births in 1999)	58	Substantially reduced from 1970 level of 145
Under-5 mortality Rate (per 1000 live births in 1999)	89	substantially reduced from 1970 level of 239
Life Expectancy at birth (1999)	61years	
Adult Literacy Rate (15 years+) (1999)	41%	
GDP size (1999)	$46.0 million	
GNP size (1999)	$47.9 billion	
GNP per Capita	$370	
GDP growth ('99-2000)	3.8%	
Agriculture value added in 1999 (% of GDP)	25.3	
Industry value added in 1999 (% of GDP)	24.3	
Services etc. value added in 1999 (% of GDP)	50.5	
Gross domestic savings (as a % of GDP) ('99-2000)	18%	
Macro-economy & Trade		
Export earnings (1999-2000)	$5,762 million	
Import payments (1999-2000)	$8,403 million	
Overall Balance of Payment (1999-2000)	+$325 million	
Foreign Exchange Reserve (June 2000)	$1,602 million	
External Debt (June 2000)	$15,791 million	
Debt as a % of GDP (June 2000)	32.9%	
Debt as a % of Exports (1999)	10%	
Repayment of external debt : principal + interest (1999-2000)	$548 million	
Official Development Assistance received (1999)	$1,203 million	
Foreign Direct Investment inflow (1999)	$179 million	
Inflation rate (2000)	3.8%	
Human Development		
Human Development Index (1999)	0.47	HDI has risen from 0.33 in 1975
Human Development ranking (1999)	132	among 162 countries

Source: compiled by the staff of the Permanent Mission of Bangladesh to the UN on the basis of data available in World Development Report 2000-2001, 2002 (World Bank), Bangladesh Bank Annual Report 2000, Economic and Social Survey of Asia and the Pacific 2001 (UN/ESCAP), Human Development Report 2001 (UNDP). Web address http://www.un.int/bangladesh/gen/country.htm. Some information also collated from World Development Indicator Database available on the internet.

Annex-III

Notes on Focus Group Discussions

Notes on Focus Group Discussion 1
Location: Chanchra Union (Poolerhat – Goalda Bazar Road, Jessore Sadar Upazila, Jessore District)
Date: 19th July 2001

Background

Arrangements for the focus group discussion were made through the Union chief on the previous day. The purpose, i.e. to seek information on local socio-economic conditions from a representative sample of the local population, was explained to the Union chief. The meeting was held in the Union meeting room. At the outset, there were 14 persons, which was perhaps too big a group for full participation by all members, though some people left during the early stages of the meeting and during the rest of the meeting when the most substantial issues were discussed, there were 8 persons including the three women. Although some two or three persons within this group were identified as representing the poorer people in the area, the majority seemed to be from average to better off farming households with other occupations. The participants appeared to be in the late 20s to early 40s age range.

General discussion of socio-economic conditions

The discussion was started by asking about the main problems affecting living conditions in the area. A large proportion of poor people and lack of employment for them was identified as the main problem. It was suggested that new factories in the locality would help to alleviate this problem. However in further discussion, some members also stated that employment prospects had improved after road improvement. There were more opportunities to work as rickshaw, van and bicycle "helicopter" operators. In addition, it was now easier to go to Jessore town to look for jobs (e.g. as transport operators).

Poor access roads to the improved road was still a serious problem for those living two or three kilometres away from the road. Lack of a telephone line and electricity were also mentioned as problems.

Economic activities

Farming

The next question discussed was the main ways of making a living. Farming was identified as the main method of earning a living. All the persons at the meeting were farmers but more than half also had other jobs or occupations (e.g. lorry driving, health clinic worker and business).

The main crops were HYV paddy, jute, potatoes and vegetables (some for sale in Dhaka). Labour requirements for farming and the busiest times in the farming calendar were then discussed. Given the range of crops and a number of activities required for each crop at different times, there was almost always something to do on farms but the busiest period was the harvesting of the main paddy crop which was in April / May.

It was necessary to harvest quickly to ensure that the crop was not damaged by heavy rains. Farmers were therefore willing to pay quite high wages to hire workers to help with harvesting, about 100 to 110 Tk per day (for 5 hours of work from 8.00 am to 1.00 pm). During the busy farming period, the wage rate was established through a bidding process. Persons working as rickshaw and van drivers also switched to being farm labourers during these periods. During less busy times, the wage rate is about 50 to 60 Tk per day for the same number of hours as above.

In response to the question: "What are the most attractive and well paid occupations ?", the responses were masonry and van driving. There have to be some qualifications about these responses as it was not clear why they were thought to be the most attractive. There might have been some very special recent circumstances which might have made masonry attractive.

Other economic activities

Other activities identified were transport operation, variety of businesses (including trading and fish farming) and casual labour.

Different standards of living

The next question discussed was the main characteristics of rich, average, poor and very poor households.

"Rich" households

Assets etc
Ownership of assets, especially land, was identified as the most important feature of rich households. It was recognised that the amount of land should be considered in relation to the number of persons in the household. Rich households would have 1.5 to 2.0 acres of land or more. They may also have larger or more profitable businesses such as fish hatcheries or some members of households may have permanent well paid jobs.

Their houses would be of permanent construction (brick walls and a tin roof) and they would own a motorbike and more than one bicycles and a power tiller.

Means of transport
Motorbike, rickshaw, van and bicycle. Women prefer not to go on buses because of social norms, comfort and security.

Extra half hour (The question posed was what household members would do if they had an extra half hour during the day.)
Both men and women would spend the time on leisure (the men would possibly go to the market and meet others socially at a café, the women would make social visits).

"Average" households

Assets etc
An average household would have between 0.5 to 0.6 acres per head of land and, in addition, may have a small business earning about 50 to 60 Tk per day. Their house would be of permanent construction (brick walls and a tin roof) but smaller than that of rich households.

The household may own one or more bicycles but no power tiller.

Means of transport
The men in this category are probably the most mobile. Their main modes are likely to be buses and bicycles. Women's modes would be similar to women from "rich" households and for similar reasons.

Extra half hour
Men would spend the time on leisure (possibly going to the market and to meet others socially at a café. Women may partly catch up on household tasks and/or make social visits).

"Poor" households

Assets etc
Poor households would have very small amounts of land per household member (no amount specified) and their members would therefore need to look for casual work. However, some of them may also have to hire workers for farming during harvesting. *(Note: The reason for need to hire during busy times was not clear. It is possible that poor small, female headed or elderly households may have to hire labour.)*

Their houses would typically be smaller than those of "rich" and "average" households and of "kutcha" construction (mud or thatched walls and thatched roof).

Means of transport
Buses and bicycles for men but less frequent than better household members.

Extra half hour
Men may look for work, women would catch up on chores or rest.

"Very poor" households

Assets etc
These households may have very small amounts of land or be landless.

Means of transport
Buses and bicycles for men but less frequent than for better-off household members.

Extra half hour
Men may look for work. Women may partly catch up on household tasks and/or make social visits.

Notes on Focus Group Discussion 2
Location: Bandbilla Union (Road Naricalbaria – Gadghat via Khanpur (R1, earth) – 8.6 km), Bagharpara Upazila, Jessore District
Date: 24th July 2001

Background

This was an impromptu and informal discussion with local people at the end of a market day at Gadghat (at the junction of the Jessore to Salikha highway and the Naricalbaria – Gadghat Road). Gadghat is an important local market for local vegetable growers with a number of trucks taking vegetables to Jessore and other centres. During the day, many farmers brought a variety if vegetables to the market along the Naricalbaria – Gadghat road and other rural roads linking with the highway.

The discussion was held in front of local stalls where some there was a social gathering of local farmers and traders who were relaxing at the end of the day.

Men only – a limitation, but adequate for the type of information – also corroborated by the more "formal" group especially on the characteristics of rich, middle and poor households.

According to participants in the discussion, the cropping intensity in the area is high. Most of the land is under 3 crops (combinations of rice and vegetables). The cost of labour varies between the busy and slack seasons, 70 to 80 Tk in the busy harvesting season (Nov/Dec) and 50 Tk in the slack (July / August). Working hours for hired labour are typically 8.00 am to 3.00 pm (7 hours). Usually workers are known to the farmers and are approached when required. The wage rate is fixed by negotiation and depends on the demand supply conditions.

The earth road is at present in poor condition as it is the rainy season. Some patches are difficult even for rickshaw vans. There is apparently no head loading in the area. Goods are usually carried on a rickshaw van or a bike – pushed by the operator if the load is too heavy or the road conditions bad.

A good indicator for identifying the better off households is by the size of the straw stack. A large stack indicates that the household has a large farm which is one reason for a household to be better off. Construction of the house (e.g. whether pucca – brick walls and tiled or tin roof - or kutcha) or its size was generally, but not always a good indicator of the income level of a household. There were examples of families who had sold their land to raise funds to build a better house for social reasons (e.g. to raise status to improve marriage prospects for daughters).

Apart from the amount of land, other explanations for being better off were a permanent job and/or business. Very few households could afford a motorcycle and ownership of one was an indication of a relatively wealthy household.

Poorer people were generally those with very little land or landless. Operators of vans and other transporters on rural roads were seen by the group as being members of the poorer population.

For cultural reasons, women do not use bicycles but there is no problem about using rickshaw vans and buses.

Annex-IV

Household Survey Questionnaire

Village:		**Upazila:**	
Household ID #:		**Date of interview:**	
Interviewer name:			

1. How many persons (including yourself) currently live in your household (HH) ? _____

2. Please give the following information about all the members of your household.

Number	HH member	HH head ? *(Show with '✓')*	Sex *(M=1, F=2)*	Age[52]
1.	Respondent			
2.				
3.				
4.				
5.				
6.				
7.				
8.				

3. Ownership of house. ***(Show with '✓')***

1	**Owned by household**	
2	**Rented by household**	
3	**Other**	

4. Total number of living rooms in the house ? _____ no

5. Principal type of construction of the house?[53] *(Show with '✓')*

1 Pucca	
2 Semi-pucca	
3 Bamboo thatched with CI sheet roof	
4 Kutcha	

6. Amount of cultivable land under household control. ***(Show amount and units.)***

Owned and cultivated by household	Leased and cultivated by household	Share cropped land

[52] Please indicate age groups by numbers: 1 for child (15 years and below), 2 for adults (16 to 60 years) and 3 for older adults (over 60 years).

[53] Pucca - Brick walls and roof, Semi-pucca – Brick walls and CI (corrugated iron) sheet roof, Kutcha – mud or thatched walls and thatched roof.

7. Amount of main crops produced last year. *(Show amount and units.)*

Crop	**Amount produced**	**Amount sold**
Paddy		
Wheat		
Jute		
Tobacco		
Other (specify)		

8. Household head's main occupation

1. Farming		10. Teaching	
2. Share cropping		11. Domestic servant	
3. Agricultural labour		12. Transport operator	
4. Construction labour		13. Government or permanent employment	
5. Other labour		14. Temporary employment	
6. Fishing		15. Student	
7. Trading		16. Housewife	
8. Retailing		17. Unemployed / Retired	
9. Construction business		18. Other (please explain)	

9. Number of adult household members in cash earning activities: _____ no.

10. What means of transport *in working order* are owned by the household ?
(Show with a '✓')

1. Truck / Bus		6. Rickshaw / Rickshaw van	
2. Car / Jeep / Pick-up		7. Bicycle	
3. Auto rickshaw / Tempo		8. Ox cart	
4. Motorcycle		9. Boat	
5. Hand tractor & trailer		10. Other (explain)	

13. Household's cash income and expenditure in the last twelve months

Source of income	Amount (Tk)	Items of Expenditure	Amount (Tk)
1 Sale of agricultural produce		1 Food and beverages	
2 Sale of livestock / dairy produce		2 Clothing	
3 Sale of fish and crustaceans		3 Education	
4 From agricultural casual labour		4 Health	
5 From other casual labour		5 Recreation	
6 From permanent employment		6 Furniture and kitchen utensils	
7 From temporary employment		7 Fuel and energy	
8 Cash remittances from relatives		8 Rent, taxes and interest	
9 From trading (including sale of sewing / weaving and other handicraft produce)		9 House construction, improvement and repair (including sanitation facilities)	
10 From providing transport services		10 Purchase of livestock	
11 From renting transport equipment		11 Excavation (pond and land development)	
12 Land / houses rental Income		12 Purchase of transport equipment	
13 Other 1 (explain)		13 Purchase of agricultural inputs	
14 Other 2 (explain)		14 Expenditure on labour (farming and livestock)	
		15 Expenditure on labour (domestic and other)	
		16 Expenditure on transport (hire, fare, maintenance)	
		17 Savings	
		18 Other 1 (explain)	
		19 Other 2 (explain)	

Annex-V

Sample Revealed Preference Questionnaire

Interviewers Name:		**Date:**	
Journey Day	Market/Non-Market	**Interview Time:**	

Direction & Destination of Travel (Please circle one):

Pulerhat ⟷ Goaldabazar ⟷ Rajgonj

Travelling alone? Yes/No **Who was paying the fare?** Traveller/Companion

1.0 Traveller's basic information

1.1 Sex: M/F/CM/CF

1.2 Age:

<= 16 yrs		2. >16 years<60yrs		3. >=60 years	

1.3 Occupation:

1	Agriculture farming		7	Trader		13	Govt or other Permanent job	
2	Share cropping		8	Retailer		14	Other temporary job	
3	Agricultural labour		9	Const. business		15	Student	
4	Construction labour		10	Teaching		16	Housewife	
5	Other labour		11	Domestic Servant		17	Unemployed/Retired	
6	Fisherman		12	Transport operation		18	Other (Pl. mention)	

2.0 Traveller's Household Information

2.1 Cultivable Land :

2.1.1 Own or leased land : _____ acres or other unit

2.1.2 Share cropping land: _____ acres or other unit

2.2 Family Size (nos.)

1. Children upto16		2. Adult over 16	

2.3 **Types of room in the household:** Pucca/Semi-Pucca/Bamboo Thatched with Tin Roof/Kutcha

2.4 No of Rooms: _____ Nos

2.5 No of Household member engaged in income earning activities: _____ Nos

2.6 Occupation of the main income earner in the household: _____

2.7 Ownership of transport mode: _____

3.0 Traveller's Journey Related Information

3.1 Journey Purpose:

	Purpose	Primary	Secondary
	1. Travelling in relation to household's basic needs		
1a	Basic household activities: water collection, firewood collection, grain grinding		
1b	Basic Agricultural activities: like cultivation (ploughing, planting, weeding), harvesting		
	2. Travelling in relation to household's wider socio-economic needs		
2a	Wider agricultural activities related travelling– for buying farm inputs, for selling produce from the farm		
2b	Business related activities: to trade (buying/selling goods for profit)		
2c	Travel to services and facilities: travel to health centres, travel to market, travel to town/administrative centres, government offices, post office, educational institutions etc.		
2d	Travel to go to economic facilities: like banks		
2e	Travelling to go to work (any type)		
2f	Travelling while working for other employer		
2g	Travelling while working as a self employed		
	3. Travelling in relation to household's social and recreational purpose		
3a	Visiting friends and relatives		
3b	For going to cinemas, theatres, club etc.		
3c	Other social and recreational		

3.2 Load type (Please write): _____

3.3 Load amount (to the nearest): _____ Kg

3.4 Traveller's Mode choice Related Information (Information for one way trip only)

Main mode: Bus/Rickshaw van

	Bus Option			Rickshaw van Option		
	Bus	Van	Bicycle	Bus	Van	Bicycle
Fare Main mode (Tk)						
Fare of access mode (Tk)						
Fare load main mode (Tk)						
Fare for access mode load (Tk)						
Waiting Time for main mode (min)						
Waiting time access mode (min)						
Vehicle Time main mode (min)						
Vehicle time access mode (min)						
Walking time (min)						

Annex-VI

Sample Stated Preference Questionnaire 1 (Pulerhat-Rajganj: Within-Mode Bus)

Interviewers Name:		**Date:**	
Journey Day	Market/Non-Market	**Interview Time:**	

Travelling alone? Yes/No	**Who was paying the fare?** Traveller/Companion

1.0 Traveller's basic information

1.1 Sex: M/F/CM/CF

1.2 Age:

<= 16 yrs		2. >16 years<60yrs		3. >=60 years	

1.3 Occupation:

1	Agriculture farming		7	Trader		13	Govt or other Permanent job	
2	Share cropping		8	Retailer		14	Other temporary job	
3	Agricultural labour		9	Const. business		15	Student	
4	Construction labour		10	Teaching		16	Housewife	
5	Other labour		11	Domestic Servant		17	Unemployed/Retired	
6	Fisherman		12	Transport operation		18	Other (Pl. mention)	

2.0 Traveller's Household Information

2.1 Cultivable Land :

(a) Own or leased land : _____ acres or other unit

(b) Share cropping land: _____ acres or other unit

2.2 Family Size (nos.)

1. Children upto16		2. Adult over 16	

2.3 Types of room in the household: Pucca/Semi-Pucca/Bamboo Thatched with Tin Roofed/Kutcha

2.4 No of Rooms: _____ Nos

2.5 No of Household member engaged in income earning activities: _____ Nos

2.6 Occupation of the main income earner in the household: _____

2.7 Ownership of transport mode: _____

3.0 Traveller's Journey Related Information

3.1 Journey Purpose:

	Purpose	Primary	Secondary
	1. Travelling in relation to household's basic needs		
1a	Basic household activities: water collection, firewood collection, grain grinding		
1b	Basic Agricultural activities: like cultivation (ploughing, planting, weeding), harvesting		
	2. Travelling in relation to household's wider socio-economic needs		
2a	Wider agriculture activities related travelling– for buying farm inputs, for selling produce from the farm		
2b	Business related activities: to trade (buying/selling goods for profit)		
2c	Travel to services and facilities: travel to health centres, travel to market, travel to town/administrative centres, government offices, post office, educational institutions etc.		
2d	Travel to go to economic facilities: like banks		
2e	Travelling to go to work (any type)		
2f	Travelling while working for other employer		
2g	Travelling while working as a self employed		
	3. Travelling in relation to household's social and recreational purpose		
3a	Visiting friends and relatives		
3b	For going to cinemas, theatres, club etc.		
3c	Other social and recreational		

3.2 Load type (Please write): _____

3.3 Load amount (to the nearest): _____ Kg

3.4 Stated Mode Choice by Traveller

	Option 1			Now	Busy	Option 2			Now	Busy
	Cost Bus (Tk)	Time Bus (Min)	Comfort			Cost Bus (Tk)	Time Bus (Min)	Comfort		
1	10	60	Uncomf			14	25	Comf		
2	12	60	Uncomf			16	40	Comf		
3	12	40	Uncomf			16	25	Uncomf		
4	12	60	Uncomf			18	25	Uncomf		
5	10	40	Uncomf			16	20	Comf		
6	12	40	Uncomf			18	25	Comf		
7	13	55	Uncomf			21	20	Comf		
8	12	40	Uncomf			20	20	Uncomf		
9	10	35	Uncomf			18	20	Comf		

Annex-VII

Alternatives, Choice Options and Values of the Variables in the Stated Preference (SP) Experiments

SP Questionnaire 1 (bus vs. bus on improved road)

Alternatives	Option 1			Option 2		
	Cost 1 (Tk)	Time 1 (Min)	Comfort2	Cost2 (Tk)	Time2 (Min)	Comfort2
1	10	60	uncomfortable	14	25	comfortable
2	12	60	uncomfortable	16	40	comfortable
3	12	40	uncomfortable	16	25	uncomfortable
4	12	60	uncomfortable	18	25	uncomfortable
5	10	40	uncomfortable	16	20	comfortable
6	12	40	uncomfortable	18	25	comfortable
7	13	55	uncomfortable	21	20	comfortable
8	12	40	uncomfortable	20	20	uncomfortable
9	10	35	uncomfortable	18	20	comfortable

SP Questionnaire 2 in round 1 (rickshaw van vs. bus on non-improved road)

Alternatives	Rickshaw van		Bus	
	Cost Van (Tk)	Time Van (Min)	Cost Bus (Tk)	Time Bus (Min)
1	19	60	22	45
2	18	80	21	30
3	20	70	23	25
4	18	70	19	45
5	22	60	23	30
6	24	80	25	25
7	25	80	22	45
8	22	70	19	30
9	25	60	22	25

SP Questionnaire 2 in round 2 (rickshaw van vs. bus on non-improved road)

Alternatives	Rickshaw van		Bus	
	Cost Van (Tk)	Time Van (Min)	Cost Bus (Tk)	Time Bus (Min)
1	12	55	14	40
2	11	75	13	30
3	13	60	15	20
4	11	60	12	40
5	15	55	16	30
6	17	75	18	20
7	15	75	14	40
8	12	60	11	30
9	15	55	14	20

SP Questionnaire 3 (bus vs. bus on improved road)

Alternatives	Option 1			Option 2		
	Cost 1 (Tk)	Time 1 (Min)	Walking 1 (Min)	Cost2 (Tk)	Time2 (Min)	Walking 2 (Min)
1	12	60	40	14	35	10
2	10	50	40	12	40	20
3	14	50	30	16	30	20
4	12	60	40	18	40	10
5	10	50	50	16	25	30
6	14	40	30	20	30	20
7	14	50	40	26	40	10
8	12	60	30	24	40	10
9	14	45	20	26	20	10

SP Questionnaire 4 (rickshaw van vs. bus on improved road)

Alternatives	Rickshaw van		Bus	
	Cost Van (TK)	Time Van (Min)	Cost Bus (TK)	Time Bus (Min)
1	6	40	7	10
2	7	35	8	20
3	5	25	6	15
4	5	40	7	15
5	6	35	8	10
6	7	25	9	20
7	6	40	9	20
8	5	35	8	15
9	7	25	10	10

SP Questionnaire 5 in round 1(rickshaw van vs. rickshaw van on non-improved road)

Alternatives	Option 1			Option 2		
	Cost Van 1(Tk)	Time Van 1 (Min)	Walk Van 1 (Min)	Cost Van 2 (Tk)	Time Van 2 (Min)	Walk Van 2 (Min)
1	18	70	50	20	40	20
2	22	80	40	24	70	20
3	20	60	20	22	40	10
4	25	60	60	33	40	30
5	20	70	40	28	40	20
6	17	80	30	25	70	20
7	16	80	50	26	70	20
8	18	70	30	28	50	10
9	20	90	30	30	60	20

SP Questionnaire 5 round 2 (rickshaw van vs. rickshaw van on non-improved road)

Alternatives	Option 1			Option 2		
	Cost Van 1(Tk)	Time Van 1 (Min)	Walk Van 1 (Min)	Cost Van 2 (Tk)	Time Van 2 (Min)	Walk Van 2 (Min)
1	10	70	50	11	45	20
2	14	80	40	15	70	20
3	12	60	20	13	40	10
4	15	60	60	18	40	30
5	10	70	40	13	45	20
6	8	80	30	11	70	20
7	10	80	50	18	70	20
8	12	70	30	20	50	10
9	14	90	30	22	65	20

SP Questionnaire 6 round 1: (bus vs. bus on non-improved road)

Alternatives	Option 1			Option 2		
	Cost 1 (Tk)	Time 1 (Min)	Walking 1 (Min)	Cost2 (Tk)	Time2 (Min)	Walking 2 (Min)
1	3	40	40	6	15	15
2	4	30	40	7	15	20
3	5	30	30	8	10	20
4	3	40	40	10	20	15
5	4	40	40	11	15	20
6	5	30	30	12	15	20
7	4	30	40	20	15	15
8	4	40	30	20	20	10
9	5	40	20	21	15	10

SP Questionnaire 6 round 2: (bus vs. bus on non-improved road)

Alternatives	Option 1			Option 2		
	Cost 1 (Tk)	Time 1 (Min)	Walking 1 (Min)	Cost2 (Tk)	Time2 (Min)	Walking 2 (Min)
1	3	40	40	5	15	15
2	4	30	40	6	15	20
3	5	30	30	7	10	15
4	3	40	40	8	20	15
5	4	40	40	9	15	20
6	5	30	30	10	15	15
7	4	30	40	15	15	15
8	4	40	30	15	20	10
9	5	40	20	16	15	5

Annex-VIII

Travel Purpose Survey Questionnaire

Name of the Road:
Road Type: FRB/R1/R2/R3
Date: Day: Market/Non-Market

Time	M/F/ CM/CF[54]	Mode	Occupation	Primary Purpose	Any Secondary Purpose? (Yes/No)

[54] M= Male; F=Female; CM= Male Child (Below 16 years); CF = Female Child (Below 16 years)

Annex-IX

Step-by-step Procedures for Designing a Stated Preference Experience

Step 1: Identification of the set of attributes

This involves making early decisions about which attributes need to be included in the experimental design and which need to be excluded. This problem may arise due to the existence of a large number of potential attributes of the alternatives in question. The decision regarding the identification of attributes should be principally based on the objectives of the study. For example, in our case the objective of the SP 3 questionnaire was to value bus in-vehicle time (IVT) and walking time values for bus passengers on an improved road. Therefore, attributes identified were bus fare, bus journey time and walking time to access the bus.

Step 2: Selection of the measurement unit for each attribute

In most cases, the measurement unit is unambiguous as was in the case of SP 3 (cost was expressed in currency unit and time in minutes). However, it may be ambiguous, as in the case of SP 1 that involved a generic attribute such as comfort. In SP1 two situations concerning comfort were considered – uncomfortable and comfortable[55].

Step 3: Specification of the number and magnitude of attribute levels and statistical design

This step concerns defining the attribute levels and their magnitude. In the case of SP 3 three attribute levels for each of the three attributes, difference between fares, difference between IVT times and difference between walking times, were chosen. The following table shows the number of levels of different attributes used in the study for different SP exercises.

Questionnaires	Fare Level difference	IVT difference	IVT difference competing Mode	Comfort	WLKT difference
SP1	3	3	N/A	2	N/A
SP2	3	3	3	N/A	N/A
SP3	3	3	N/A	N/A	3
SP4	3	3	3	N/A	N/A
SP5	3	3	N/A	N/A	3
SP6	3	3	N/A	N/A	3

Note: WLKT = walking time; NA = Not Applicable

[55] A bus journey is considered uncomfortable if the bus is overcrowded, which is a common feature in rural Bangladesh. The passenger is unlikely to get a seat during his/her entire journey. By contrast, a bus journey is considered comfortable if the bus is not overcrowded and the passenger is expected to get a seat for the major part of the journey. While conducting the SP experiment, the meaning of such terms needs to be clarified to the respondents.

Next the attribute levels are combined into an experiment. The first task is to decide on the number of alternatives – combination of attribute levels – to be presented to the respondents. In most of the cases, the 'full factorial design' – which involves every possible combination of attribute levels – is avoided given its impracticality and to reduce fatigue and subsequent increase in response errors. For example, in the case of SP 3 there were three attributes and each had three levels for each of the attributes. Therefore, $27(3^3)$ possible combinations would need to be presented to the respondents in case of full factorial design. Presenting these 27 alternatives to a respondent in rural Bangladesh with limited educational background and unfamiliarity with such type of exercise was considered impractical. For this reason fractional factorial design was used. This was done with the help of the catalogue of Master Plans for the fractional factorial design provided in Kocur et. al. (1982). In the case of SP-3 9 alternatives were used, the minimum requirement for three attributes with three levels each. Plan Code 16a (Master Plan 3) from Kocur et. al. (1982) was adopted. The combinations used were:

Alternative	Cost difference[56]	Walking time difference	In-vehicle time difference
1	0	0	0
2	0	1	2
3	0	2	1
4	1	0	1
5	1	1	0
6	1	2	2
7	2	0	2
8	2	1	1
9	2	2	0

The next step involves the establishment of different attributes values to be presented to the respondents. This needs doing in a systematic manner – with the help of boundary values of different alternatives by setting up a boundary value equation. The following example explains the concept of boundary value.

For example, if an individual is faced with two choices for going from A to B – travelling by train which is faster but expensive or travelling by coach which is slower but cheaper. Say the times and costs for travel are T_t and C_t, and T_c and C_c for train and coach respectively. Then the time and cost differences are $(T_c\text{-}T_t)$ and $(C_t\text{-}C_c)$ respectively. Under this circumstance the boundary value of time (BVOT) is $\{(C_t\text{-}C_c)/ (T_t\text{-}T_c)\}$- which practically means that any individual with value of time equal to $\{(C_t\text{-}C_c)/ (T_t\text{-}T_c)\}$will be indifferent between the train and bus. All else equal, an individual with value of time higher than $\{(C_t\text{-}C_b)/ (T_t\text{-}T_b)\}$ would choose the train and vice versa.

In case of SP-3 apart from in-vehicle time and cost variables, there was another variable, walking time. Therefore, the boundary value equation was:

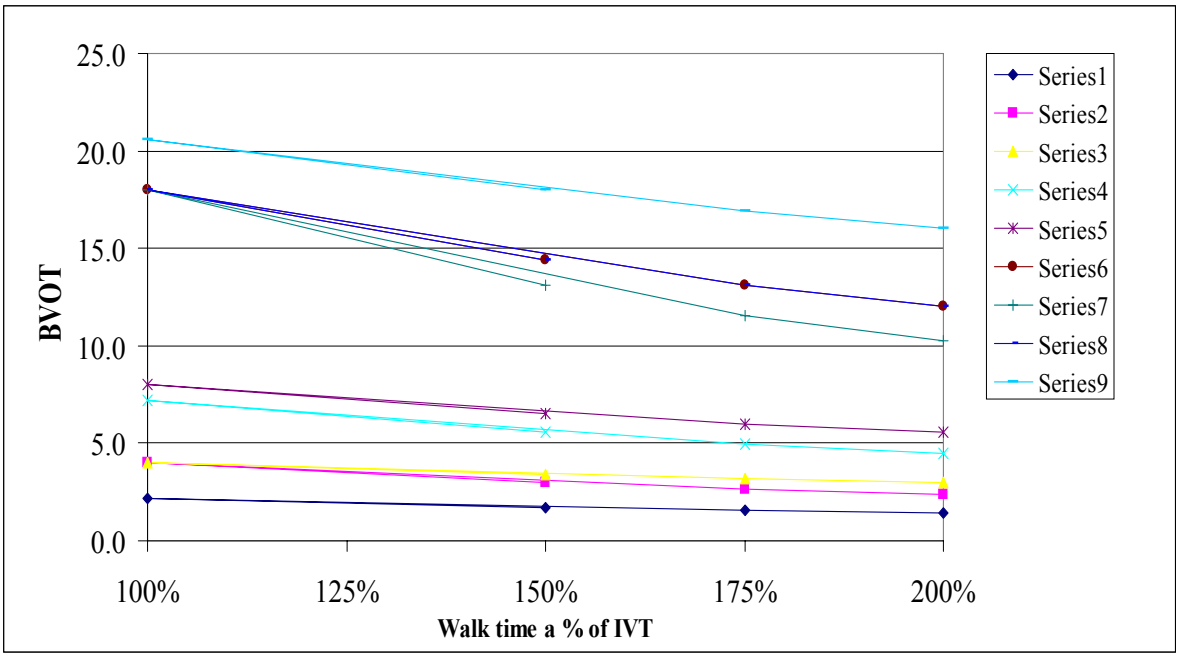
$$\lambda = (C_2 - C_1) \big/ ((T_1 - T_2) + a * (W_1 - W_2))$$

[56] 0 means most favourable to future and 2 means most unfavourable to future

Where λ = Boundary value of time; C_1 & C_2 = Bus fare under Option 1 and Option 2 respectively; T_1 & T_2 = In-vehicle time within bus under Option 1 and Option 2 respectively; W_1 & W_2 = Walking time under Option 1 and Option 2 respectively; and a = value of walking time as a proportion of in-vehicle time. Next the BVOT for all nine alternatives was calculated using a trial and error method in such a way that they were more or less evenly distributed and could cover the range of values to capture time values of respondents from different social classes. In the case of SP3 the range was from 1.71 Tk/hour to 18.00 Tk/hour[57]. Also the values were set in such a way that they were believable in terms of the existing situation.

Alternatives	**Cost difference (Tk)**	**Walking time difference (Min)**	***In-vehicle time difference (Min)***	**BVOT (Tk/hr)**
1	2	30	25	1.71
2	2	20	10	3.00
3	2	10	20	3.43
4	6	30	20	5.54
5	6	20	25	6.55
6	6	10	10	14.40
7	12	30	10	13.09
8	12	20	20	14.40
9	12	10	25	18.00

To facilitate this exercise a visual simulation may also be constructed. The following graphs for BOVTs against proportion of walking time to IVT were constructed for the case of SP-3 to understand the experimental design procedure.



[57] Walking time values are assumed as 150% of the IVT values. i.e (a=1.5)

Step 4: Setting up the alternatives in the questionnaire

Once the statistical design is completed, i.e. the numbers and levels of attributes, number of options to be presented to the respondents, and the values of the attributes are decided, the next step is the incorporation of this design into the questionnaire. In the case of SP-3 the attributes were the differences between fares, IVT and walking time. These differences were then translated into actual fares, IVTs and walking times for different alternatives to facilitate the understanding of the respondents. While setting up the actual alternatives, care should be taken so that the values presented are as realistic as possible. Collection of existing travel attributes (fare, travel time etc.) for the particular journey is helpful in setting up the attribute values. In the case of SP-3, the existing bus journey from Pulerhat to Rajganj costs 12 Tk and takes about 50 minutes. This information was established beforehand by interviewing bus operators and passengers. The travel attributes values may also subjected to seasonal variations, as in the case of Naricalbaria to Gaidghat road via Khanpur road, due to changed travelling condition in the dry season compared to the wet season. In such cases, there is a need to change the attribute values in a choice exercise depending on the time of survey in a year. The choice part of the SP-3 questionnaire was presented in the local language, Bangla, in the following fashion.

Alternatives	Option 1				Option 2			
	Cost Bus (Tk)	Time Bus (Min)	Walk Time (Min)	Choice	Cost Bus (Tk)	Time Bus (Min)	Walk Time (Min)	Choice
1	12	60	40		14	35	10	
2	10	50	40		12	40	20	
3	14	50	30		16	30	20	
4	12	60	40		18	40	10	
5	10	50	50		16	25	30	
6	14	40	30		20	30	20	
7	14	50	40		26	40	10	
8	12	60	30		24	40	10	
9	14	45	20		26	20	10	

Step 5: Administration of choice questionnaire

How the SP surveys are carried out depends on the particular circumstances. In our case all questionnaires were administered by the interviewer considering the literacy level of the respondents. Respondents were informed about the attribute values and were asked to choose between two options. All nine alternatives were administered sequentially.

Annex-X

Descriptions of the Study Roads

Study roads	Description
Pulerhat – Goalda Bazar - Rajganj road (FRB, paved) Total length - 19.0 km	Links a rural Growth Centre (GC), Rajganj, to a national highway (Khula-Jessore-Benapole Road). Passes through Chanchra Union, Jessore Sadar Upazila and Rohita, Khedapara, Japha and Chaluahati Union, Monirampur Upazila. Jessore town is about 4 km to the north-east of one end of the road. Paved about five years ago and currently in a good condition. Used by all types of vehicles, motorised and non-motorised. A total of 5 markets, Pulerhat, Goaldabazar, Mahedia bazar, Bagerhat and Rajgonj hat, situated on this road. Represents a rural road in a relatively well-developed area with good communications links and urban influence because of proximity to Jessore, the District HQ. No seasonal influence on modal mix, travel costs and travel time.
Bagherpara – Naricalbaria road (FRB, paved) Total length - 8.0 km	Links a rural GC, Naricalbaria to the Upzila HQs, Bagherpara, and subsequently to the district HQs, Jessore, through a national highway. Passes through 3 Unions, Naricalbaria, Darajhat and Dohakula, in Bagherpara Upazila. Chosen as a road with low urban influence but with same potential function as of Pulerhat-Rajganj road. An earth road till early 90s and subsequently improved to all weather condition. However, currently in a very poor condition due to non-maintenance. Represents poor condition paved road. Bus, bicycle and rickshaw van are the main modes; ply with great difficulty in wet season. Has moderate seasonal influence on modal mix, travel costs and travel time.
Naricalbaria – Khanpur-Gaidghat (R1, earth) road – Total length - 8.6 km	Links two Unions, Naricalbaria and Bandbilla, in Bagherpara Upazila. One end terminates on a national highway (Khulna-Jessore-Dhaka). Represents a road in a relatively less developed area and with low urban influence. Rickshaw van, bicycle and bullock cart are the main modes. Impassable by motorised transport in the wet season and occasionally frequented by motorised transport in the dry season. Non-motorised transport negotiates the road with great difficulty in the wet season. Represents a non-improved poor condition road. Subjected to substantial seasonal influences on modal mix, transport costs and travel time.
Bakhra - Bagachra road – (FRB- partially paved but mainly Earth) – 10.5 km	Passes through Hazirbag & Shankarpur Unions of Jhikargacha Upazila of Jessore District. Connects Bakhra GC to a FRA. This is a partially paved road – approximately 4.5 km length is paved. Bicycle, rickshaw van and bullock cart are the main modes. It passes through a densely populated area. Aman (Summer-Autumn rice) is produced in vast quantity along this road corridor.
Bagerhat - Kamalpur road (R1-earth) Total length -10.20 km	Passes through Chanchra Union of Jessore Sadar Upazila. Main modes on this roads are bicycle, rickshaw van, motorcycle and bullock cart. However, it is difficult to access some parts of the road by some modes during the wet season. This road connects a small rural market, a college, a high school and primary schools, and a UP office.
Shadipur – Sheordah road – (R2-earth) Total length - 3.10 km	Passes through Hazirbag & Nirbash Khola Unions of Jhikargacha Upazila. Although difficult to access in the wet season, this road remains in fair condition in the remaining part of the year. Rickshaw van and bicycle are the main modes operate on this road.
Lebutala - Paranpur road (R3-earth) Total length - 7.55km	Passes through Lebutala Union of Jessore Sadar Upazila. Connects two end of the Union. Difficult accessing in wet season by transport modes. Rickshaw van and bicycles are the main mode during rest of the year; also frequented by bullock cart.

Results of the Household Consumption Econometric Models Table

Model No.			Dependent Variable		Independent variables											
				CONSTAN	LNLANDCA	LANDCAP	NOOCCU	DUMROOM	DUMJOB	DUMTRANS	DUMBUSIN	DPERJOB	DPERBUSI	DUMAREA	HHADULT	LANDEQUI
	F-VALUE	**Adj. R Square**	**Explanation of the variables**	Constant	Log of Land Capita	Land per capita	No involved in economic activities	Dummy for permanent type of rooms	Dummy for job	Dummy for owning motorised transport I/c motor cycle	Dummy for business	Dummy for permanent job	Dummy for permanent business	Dummy for area (Sadar=1, Bagharpara=0	No of household adult	Equivalent amount of land (Acres)
1	14.281	0.46961	LNCAPCON	8.795906	0.199209			0.079225	0.644002	0.630321	0.15097					
2	17.550	0.46884	LNCAPCON	8.821057	0.198474			0.077386	0.62096	0.619326						
3	17.837	0.47312	LNCAPCON	8.836187	0.206599				0.669932	0.64828	0.149287					
4	35.987	0.69713	LNCAPCON		-2.267448			5.990374	2.713729	5.156778	3.530249					
5	70.833	0.84646	LNCAPCON		-1.085504		3.760339	2.556007	-0.768539	3.409245	1.558723					
6	72.381	0.82476	TOTCONSU						29131.017	65561.3014	10490.3247			-1966.11176	10757.973	585.314055
7	87.661	0.82644	TOTCONSU						29078.847	65779.7527	10046.3491				10548.482	584.638426
8	107.738	0.82431	TOTCONSU						27335.091	68378.5666					11001.776	572.654427
9	107.193	0.82357	TOTCONSU				26391.617		27687.593	68695.4544						642.612787
10	47.927	0.75574	PERCACON			466.32766	3266.4849	1513.32575	4692.6783	11779.1773	3328.70245					
11	13.004	0.40008	PERCACON	4159.12388		447.75409	1139.7999		4613.909	12393.1622	2253.36196					
12	43.322	0.76501	PERCACON			478.56941	2352.8177		4597.6212	12835.0291	2993.07505			2058.534958	332.11379	
13	48.316	0.75727	PERCACON			470.10571			4810.0366	12772.6333	3454.19648			2183.679952	1217.4913	
14	15.426	0.39068	PERCACON	5498.45963		455.85728			5037.9564	12400.9536	2295.43457					
15	29.570	0.55671	PERCACON			753.37998			9815.9192	13902.387	7610.35564					
16	33.400	0.64031	PERCACON			567.31909		5015.73519	7918.0226	10413.1028	6115.96755					
17	65.201	0.73836	PERCACON			474.97801	4047.4842		4100.781	13539.6409						
18	56.385	0.75267	PERCACON			495.73475	3644.6087		4738.5303	12708.0365	3336.13767					
19	50.795	0.76653	PERCACON			489.11232	3095.9509		4666.3406	12905.0714	2925.87347			2128.231741		
20	56.366	0.7526	PERCACON			440.26048	3813.3398			12215.1359		5758.3634	3474.008			
21	52.430	0.77226	PERCACON			417.68568	3123.9911			12356.1307		6244.7916	2978.155	2487.86204		

Note

LNCAPCON: Log of per capita consuption

TOTCONSU: Total consumption

PERCAPCON: Per capita consuption

Siginficant at 95% CL

Analysis Strategy for Preference Data & Model Estimation

Step 1: Developing the mathematical specification of the models

The objective of the analysis of stated preference data (as well as revealed preference where applicable) is to decompose the overall preference into part utilities attached to each used or used attributes. In our case, the overall utility equation, a linear model of utility, was of following form:

$$U_i = c + \sum a_i * x_i + \sum b_i * d_i$$

Where U_i = Utility of option 1;

C_i = Constants to capture effects of subtle attributes like inclination towards use of car;

x_i = travel attributes like in-vehicle time, walking time and fare;

d_i = dummy variables like male vs. female, poor vs. non-poor etc.;

a_i = model coefficients of continuous variables; and

b_i = model coefficients of discreet (dummy) variables.

The model coefficients were used, among other things, to determine the relative importance of the attributes. This included the determination of the relevancy of a particular coefficient; and to determine the values of travel time savings.

Step 2: Model Estimation

ALOGIT (version 3.8) software, that uses the logit technique with the statistical principle of likelihood maximization, had been used in the estimation of the model parameters[58]. When the utility equations were specified and the models were run, the software provided the model coefficients with their statistical significance. Using statistical reasoning, the irrelevant coefficients were eliminated in different steps – e.g. the ones with improper signs and/or statistically insignificant – from the utility equations and the best models were estimated.

Step 3: Calculation and reconciliation of time saving and attribute values

The values of time were calculated by dividing the particular co-efficient with the cost coefficient. For example if the cost coefficient was λ and the in-vehicle time coefficient was γ then the time value was calculated at γ/λ. However, where a study involves use of several

[58] For more information: http://www.hcg.nl/software/alo_intr.htm

stated preference experiments, the reconciliation of different time and attribute values may not as straightforward as described above. In our case, the study involved seven types of preference questionnaires - six types of stated preference choice experiments and a revealed preference questionnaire. The following sections describe the strategy undertaken to reconcile different time and attribute values:

As a first attempt for modelling the SP data, response data from similar types of questionnaire were combined for joint analysis (Table XI-1). SP 1 and SP 6, and SP 2 and SP 4 were chosen for development of separate Multinomial Logit Models (MNL). Because of the different nature of nature variables and that there could be different taste variation among the respondents, responses of SP3 and SP5 were modelled using the Hierarchical Logit (HL) modelling concept using the simultaneous estimation method[59]. Table XI-2 presents the results of the preferred models from such analyses.

Table XI -1: Initial Modelling Strategy for first round (wet season) data

	Road Type	Respon-dents	Type	Developed Models	Variables					
SP1	Improved	Bus passenger	Bus-within	MNL	Cost bus	IVT bus	Comfort			
SP6	Non-imp	Pedestrian	Bus – within		Cost bus	IVT bus				Walk
SP2	Non-Imp	Van passenger	Van-Bus	MNL	Cost bus	IVT bus		Cost van	IVT van	
SP4	Improved	Van passenger	Van–bus		Cost bus	IVT bus		Cost van	IVT van	
SP3	Improved	Bus passenger	Bus-within	HL	Cost bus	IVT bus				Walk
SP5	Non-imp	Van passenger	Van – within					Cost van	IVT van	Walk

Table XI -2 shows the wide-ranging base in-vehicle time saving and other travel attributes values from the analyses of the first round of data (wet season). This made it difficult to make valid conclusions on values of travel time savings and other travel related attributes. Faced with this problem, nested logit (or HL) models were developed combining all the SP responses from first round of data. Table XI-2 also presents the results of the preferred models after the combined analysis. This approach helped in the reconciliation of the responses from the different SP exercises. Several attempts were made to model the data from RP questionnaire. However, no reasonable results could be obtained.

[59] For details on HL models (also known as nested logit) see Ortuzar and Willumsen (1996) and Hensher (1994).

Table XI - 2: Summary of the chosen models and estimated values of travel time savings from the analysis of first round of data

	Combined SP1&6	Combined SP2&4	Combined SP3&5	Combined All SP
Base Value of Travel Time Savings (Tk/hr)				
IVT bus	2.92	**	**	**
IVT rickshaw van	N/A	**	**	**
IVT	N/A	2.09	6.17	3.34
Walk	*	N/A	7.01	3.99
Additional Value (Tk/hr)				
Uncomfortable travelling condition	N/S	N/A	N/A	N/S
Market day	1.26	N/S	8.84	0.51
Male traveller	N/S	5.1	N/S	2.82
Major Non-farm earner	7.13	15.16	18.87	16.35
Social & leisure travel	N/S	N/S	N/S	N/S
Travelling with load	0.38	N/S	N/S	0.43
Poor traveller	0.31	N/S	1.87	1.22
Travelling on improved road	N/S	-1.07	-2.61	N/S
Other Statistics of the Models				
Rho_Sq	0.1116	0.0536	0.111	0.0898
Rho_sq Const	0.0895	0.0535	0.1105	0.0628
Scale Factor SP1	N/A	N/A	N/A	N/A
Scale Factor SP2	N/A	N/A	N/A	1.375
Scale Factor SP3	N/A	N/A	0.9281	1.958
Scale Factor SP4	N/A	N/A	N/A	1.491
Scale Factor SP5	N/A	N/A	N/A	0.9967
Scale Factor SP6	N/A	N/A	N/A	2.39

Note: N/A – Not Applicable; N/S – Non-significant. USD 1 = Tk 57

After the collection of round 2 (dry season) data, SP and RP data from both rounds were combined and analysed using Hierarchical Logit (HL) modelling concept for estimation of time and other attributes values. The final tree structure was as the one in Figure XI-1. In our case, the analysis started with RP in the upper nest. During analysis it was found that the scale factor of SP4 was insignificant and, therefore, it was subsequently shifted to the upper nest as well.

SP data from both rounds were also analysed. In this case SP1 was kept in the upper nest. Like the combined analysis, scale factor for SP4 was also insignificant in this case. Therefore, SP4 was subsequently shifted to the upper nest.

** IVTs of bus and van combined were estimated.

* Value of time for walk was found insignificant when treated separately. Therefore, it was treated jointly with IVT

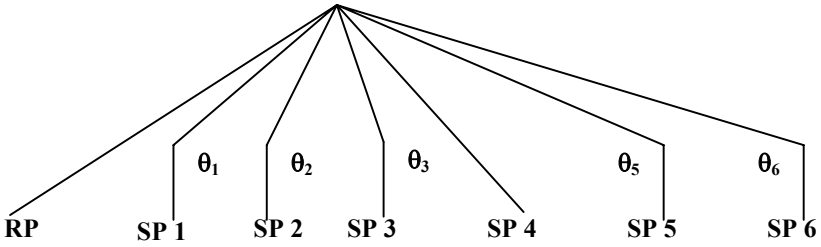


Figure : XI -1 : Final tree structure (combined analysis) of the hierarchical logit

This HL (also known as nested logit) modelling technique is adopted when data from different sources – like data from SP and RP exercises or different types of SP exercises – are mixed. Such a type of modelling technique is required to take care of the difference in the variances of the error terms when data from different sources are mixed. When the nested logit modelling technique is used, then the true utility (U) is obtained by: $U = \theta\ (U_{pref})$; where, θ is the scale factor correcting the differences in variance, and U_{pref} is the preference utility obtained from SP experiments or RP data.

Annex-XIII

Model Estimation Results

Coefficients	Type of variable	Dummy value applied to	Coefficients (t statistics)		
			Combined SP	Combined SP & RP	RP only
Cost	Continuous	N/A	-0.1138 (10.2)	-0.1064 (-7.9)	-0.1482 (-4.2)
IVT	Continuous	N/A	-4.26E-03 (-3.6)	-4.07E-03 (-3.7)	-0.0189 (-4.2)
Walk	Continuous	N/A	-5.04E-03 (-4.1)	-4.64E-03 (-3.6)	N/S (N/A)
Uncomfortable travelling condition	Dummy	Time	-4.34E-03 (-3.6)	-4.06E-03 (-3.6)	N/S (N/A)
Market day travel	Dummy	Time	-2.78E-03 (-3.1)	-2.34E-03 (-2.8)	N/S (N/A)
Male	Dummy	Time	-4.75E-03 (-3.9)	-4.45E-03 (-3.7)	N/S (N/A)
Fixed income earner	Dummy	Time	-2.79E-02 (-9.4)	-2.62E-02 (-7.7)	N/S (N/A)
Travelling with load	Dummy	Cost	1.99E-02 (4.8)	1.98E-02 (4.5)	0.1465 (4.0)
Poor traveller	Dummy	Cost	1.38E-02 (3.4)	1.26E-02 (3.3)	N/S (N/A)
Travelling on poor road	Dummy	Cost	N/S (N/A)	N/S (N/A)	0.0770 (2.1)

Annex-XIV

Calculation of the Rural Average Wage Rate in Bangladesh[60]

From Secondary data

a) Share of non-agricultural sector in employed population : 39.6% (1995-96) (Source: Mahmud, 1996)
b) Agriculture wage rate: Tk 37.73/day in 1996 (Source: Varma & Kumar, 1996)
c) Working days a week : 6 (Source: Varma & Kumar, 1996)
d) Average hours per week by rural employees: 53.5 (Source: Varma & Kumar, 1996)
e) Average hours per day by rural employee: 53.5/6= 8.92 hours
f) Agricultural wage rate as a proportion of non-agricultural wage rate: 70% (Source: Varma & Kumar, 1996)
g) Rate of growth in rural wage: assumed no increase[61]
h) Rate of inflation: 6.64% [62]
i) Weighted average wage rate per rural employee: [{37.72/8.92*(1-0.396)}+ {(37.72/8.92*0.396)/0.7)}] *(1+0.0664)**5 = 6.82 Tk/hour

Calculation of Rural Average Wage Rate from Field Interviews

Agriculture labour wage rate:

Month	Wage Rate
mid-Mar. to mid-May. (2 months)	Tk 30 per day
mid-May to mid-Jun. (2 months)	Tk 90 per day
mid-Jun.–mid-Aug. (2 months)	No or marginal work
mid-Aug. to mid-Mar. (7 months)	Tk 50 per day
Weighted Average for the year	Tk 42 per day

[Source: Village level interviews]

Average working hours: 7 hours/day
Average wage/hour for agricultural labour: Tk 6/hour

Assuming the share of non-agricultural employment is 40%, and the agricultural wage rate is 70% of the non-agricultural wage rate, the overall wage rate per hour is calculated at Tk 7.02/hour. This value is close to the wage rate calculated from secondary data, i.e. Tk 6.82/hour.

[60] Information on rural wage levels is scarce is Bangladesh. Therefore, this estimates of rural wage may not be precise – it should only be treated as broad indicator.
[61] No data available. Varma and Kumar (1996) presented a contradictory picture. Therefore, assumed as no real increase
[62] From 1990 to 1999, Bangladesh's weighted average annual rate of inflation was 6.64 percent, up from 3.8 percent from 1989 to 1998. Source:http://database.townhall.com/heritage/index/country.cfm?ID=11

Estimation of the SCF and the SWRs

Estimation of the Standard Conversion Factor (SCF)

	Tk Million				Average
	1996-97	**1997-98**	**1998-99**	**1999-00**	
1. Value of total Imports CIF (Million Tk)	271,790	307,658	346,544	379,449	326,360
2. Value of total Exports FOB (Million Tk)	188,130	234,164	254,911	288,185	241,348
3. Import and Export	459,920	541,822	601,455	667,634	567,708
4. Import Duty (Million US$)	73,685	75,849	77,761	83,252	77,637
5. Total Export Duty (Million US$)	0	0	0	0	0
SCF = row 3/[row 3 + row 4+row 5]	**0.88**				

Source: Bangladesh Bureau of Statistics (2001)

Estimation of the Shadow Wage Rates (SWRs)

		Rural Unskilled Labour	Rural Skilled Labour
SW=	m*p+[w-m]*[1-1/v]*c	72.31	92.56
m=	Value of Marginal product of labour at market price [a]	83	105
p=	Border/domestic price ratio [b]	0.88	0.88
m*p=	Opportunity cost of labour	73.01	92.37
w=	Actual wage rate[c]	100	100
c=	Border/domestic consumption [d]	1	0.88
v=	Value of investment relative to consumption [the shadow price of investment relative to consumption or the social cost of consumption] = k[1-s]/CRI-[k*s]]	0.96	0.96
	Where k = marginal product of capital [e]	0.12	0.12
	s=rate of savings [f]	0	0.05
	CRI=consumption rate of interest [g]	0.125	0.125
	SWR=SW/W	**0.72**	**0.93**
	Weighted average SWR for rural traveller [h]	**0.75**	

Sources: Shahabuddin & Rahman (1992); Squire & van der Tak (1975)

[a] Field interviews in Jessore suggest that rural unskilled labour employed on average 10 out of 12 months. i.e. .833. Assumed public private sector mix is 50:50 for skilled labour. Assumed public sector rate is 10% higher for skilled labour [50+55]=105

[b] The Standard Conversion Factor (SCF)

[c] Expressed in terms of 100

[d] For unskilled labour import content assumed to be negligible

[e] Opportunity cost of capital assumed at 12%

[f] Assumed 5% for skilled labour and negligible for unskilled labour

[g] Average lending rate of banks in rural areas. Lending rate of nationalised commercial banks ranges from 9% to 16% depending on the type of activities undertaken by the borrowers (Bangladesh Bank, 2001). Average 12.5% assumed

[h] (SWR of unskilled labour)* r + (SWR of unskilled labour) * (1-r); where, r = proportion of unskilled worker travelling on rural roads = 0.87 (source: travel purpose survey data)